US009097686B2

(12) **United States Patent**
Bamba et al.

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(45) **Date of Patent: Aug. 4, 2015**

(54) **OPTICAL TYPE INSPECTION APPARATUS, INSPECTION SYSTEM AND THE WAFER FOR COORDINATES MANAGEMENT**

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(73) Assignee: **HITACHI HIGH-TECHNOLOGIES CORPORATION**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 54 days.

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(2), (4) Date: **Dec. 27, 2013**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
G01N 21/95 (2006.01)
H01L 21/66 (2006.01)
G01N 21/956 (2006.01)

(52) **U.S. Cl.**
CPC ***G01N 21/9501*** (2013.01); *G01N 21/956* (2013.01); *H01L 22/12* (2013.01)

(58) **Field of Classification Search**
CPC . G01N 21/94; G01N 21/9501; G01N 21/956; H01L 22/12
USPC 356/237.1–237.5, 243.1–243.8; 438/16, 438/18, 460; 257/48, 797
See application file for complete search history.

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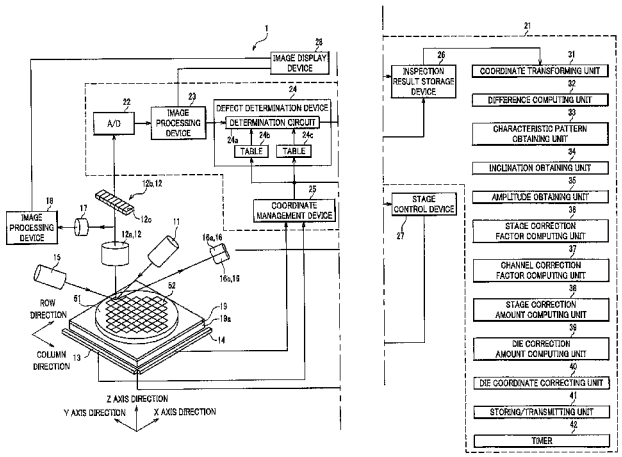
Primary Examiner — Hoa Pham
(74) *Attorney, Agent, or Firm* — McDermott Will & Emery LLP

(57) **ABSTRACT**

This optical inspection device has: a line sensor on which channels are arranged; a moving means for moving a wafer mounted on a stage relative to the line sensor; a stage position detection means for detecting the on-stage positions of pseudo-defects in images formed on the channels as pseudo-defect stage coordinates, said coordinate management wafer being a wafer on which one pseudo-defect die is formed per row and column of a matrix of dies and each pseudo-defect die has a plurality of pseudo-defects formed in a line in the columnar direction; a coordinate transformation means for transforming the pseudo-defect stage coordinates into pseudo-defect die coordinates; a difference computation means for computing the differences of the pseudo-defect die coordinates from design coordinates; and a characteristic pattern acquisition means for obtaining a coordinate error characteristic pattern in which the differences from the pseudo-defect stage coordinates increase or decrease along a straight line.

13 Claims, 27 Drawing Sheets



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* cited by examiner

FIG.1A

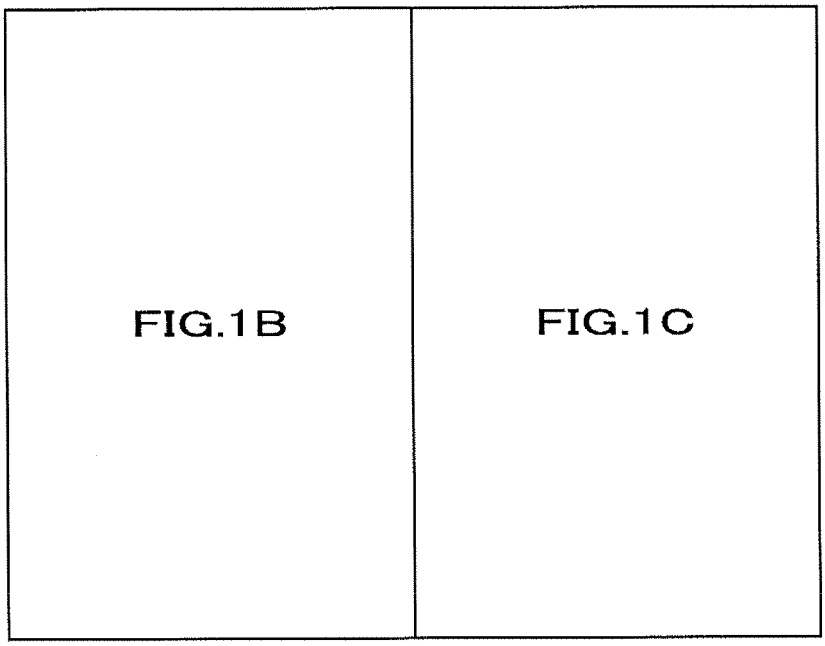


FIG.1B

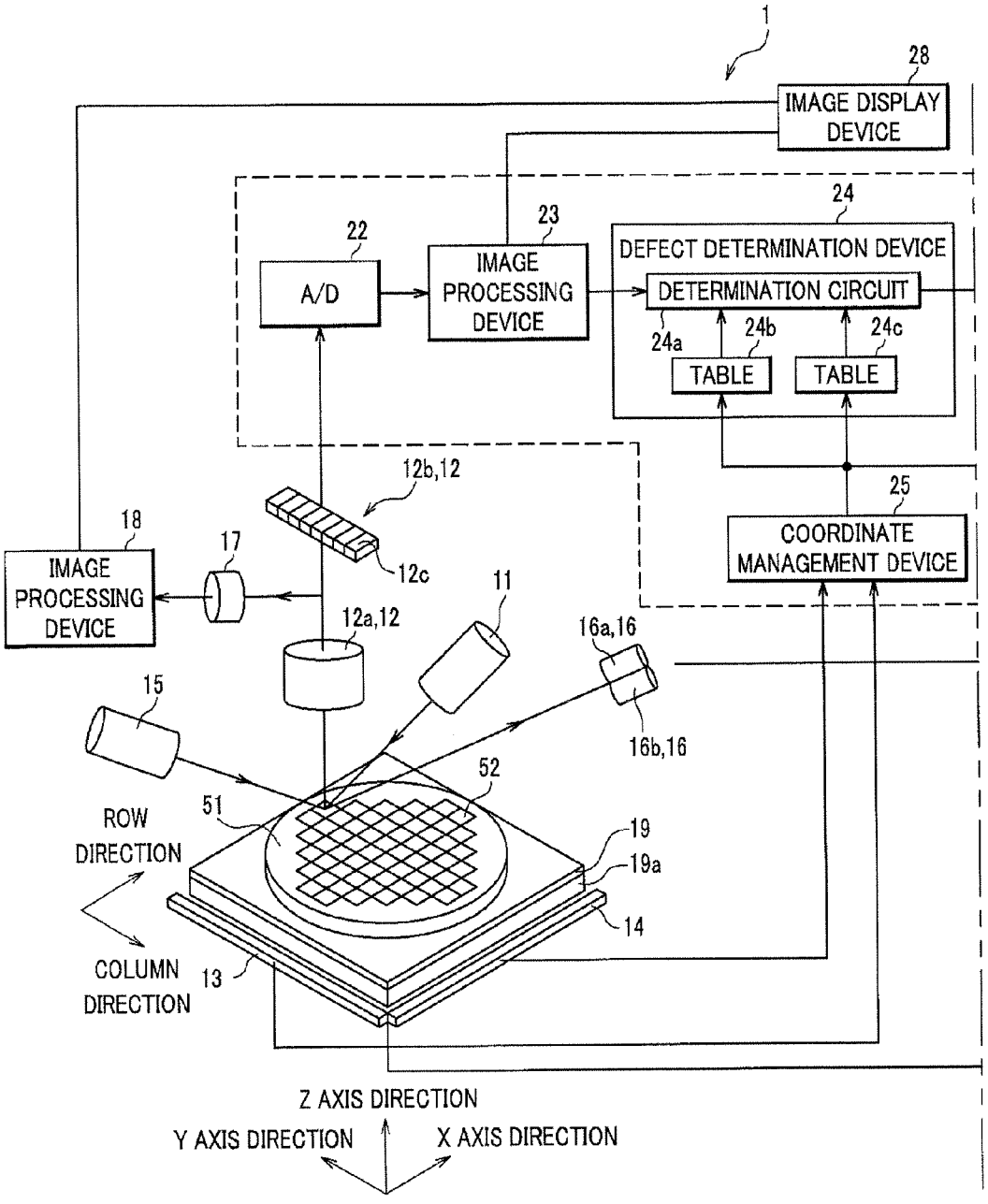

1
28
IMAGE DISPLAY DEVICE
24
22
23
A/D
IMAGE PROCESSING DEVICE
DEFECT DETERMINATION DEVICE
DETERMINATION CIRCUIT
24a
24b
24c
TABLE
TABLE
12b,12
25
18
17
12c
11
COORDINATE MANAGEMENT DEVICE
IMAGE PROCESSING DEVICE
12a,12
16a,16
15
16b,16
52
51
ROW DIRECTION
19
19a
14
COLUMN DIRECTION
13
Z AXIS DIRECTION
Y AXIS DIRECTION
X AXIS DIRECTION

FIG.1C

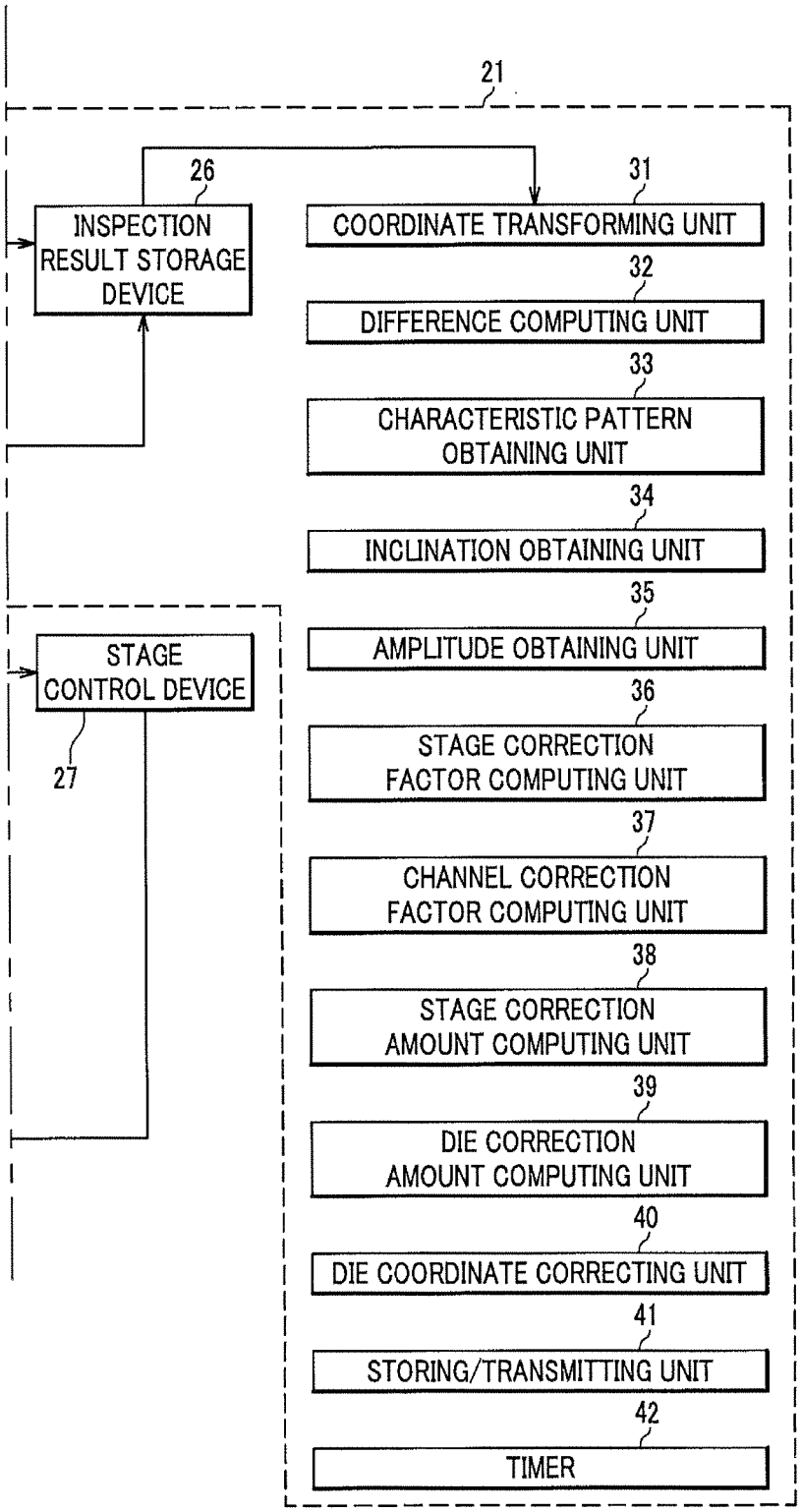

21
26
INSPECTION RESULT STORAGE DEVICE
31
COORDINATE TRANSFORMING UNIT
32
DIFFERENCE COMPUTING UNIT
33
CHARACTERISTIC PATTERN OBTAINING UNIT
34
INCLINATION OBTAINING UNIT
35
AMPLITUDE OBTAINING UNIT
36
STAGE CORRECTION FACTOR COMPUTING UNIT
37
CHANNEL CORRECTION FACTOR COMPUTING UNIT
38
STAGE CORRECTION AMOUNT COMPUTING UNIT
39
DIE CORRECTION AMOUNT COMPUTING UNIT
40
DIE COORDINATE CORRECTING UNIT
41
STORING/TRANSMITTING UNIT
42
TIMER
STAGE CONTROL DEVICE
27

FIG.2

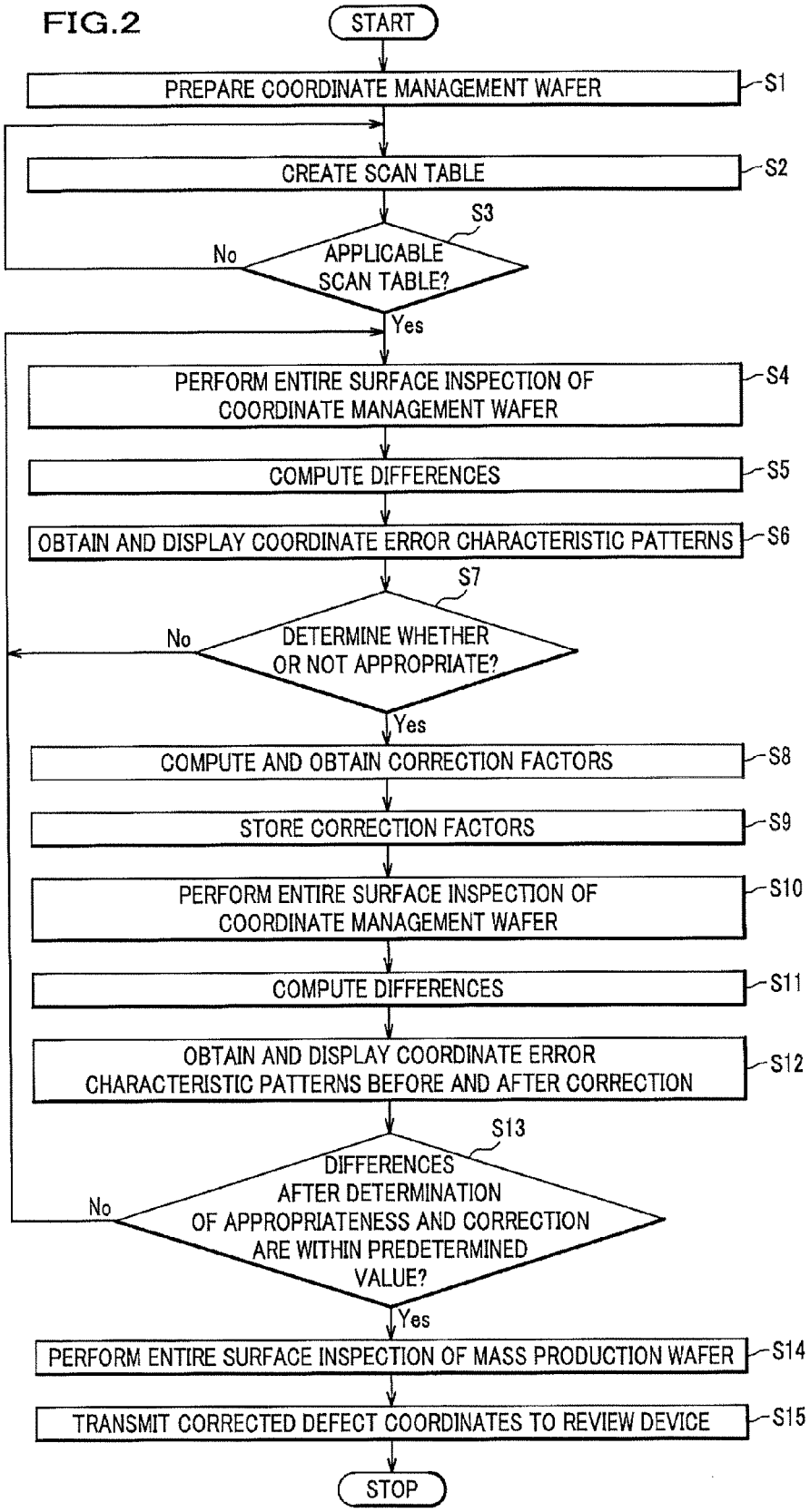

START
PREPARE COORDINATE MANAGEMENT WAFER
S1
CREATE SCAN TABLE
S2
S3
APPLICABLE SCAN TABLE?
No
Yes
PERFORM ENTIRE SURFACE INSPECTION OF COORDINATE MANAGEMENT WAFER
S4
COMPUTE DIFFERENCES
S5
OBTAIN AND DISPLAY COORDINATE ERROR CHARACTERISTIC PATTERNS
S6
S7
DETERMINE WHETHER OR NOT APPROPRIATE?
No
Yes
COMPUTE AND OBTAIN CORRECTION FACTORS
S8
STORE CORRECTION FACTORS
S9
PERFORM ENTIRE SURFACE INSPECTION OF COORDINATE MANAGEMENT WAFER
S10
COMPUTE DIFFERENCES
S11
OBTAIN AND DISPLAY COORDINATE ERROR CHARACTERISTIC PATTERNS BEFORE AND AFTER CORRECTION
S12
S13
DIFFERENCES AFTER DETERMINATION OF APPROPRIATENESS AND CORRECTION ARE WITHIN PREDETERMINED VALUE?
No
Yes
PERFORM ENTIRE SURFACE INSPECTION OF MASS PRODUCTION WAFER
S14
TRANSMIT CORRECTED DEFECT COORDINATES TO REVIEW DEVICE
S15
STOP

FIG.3

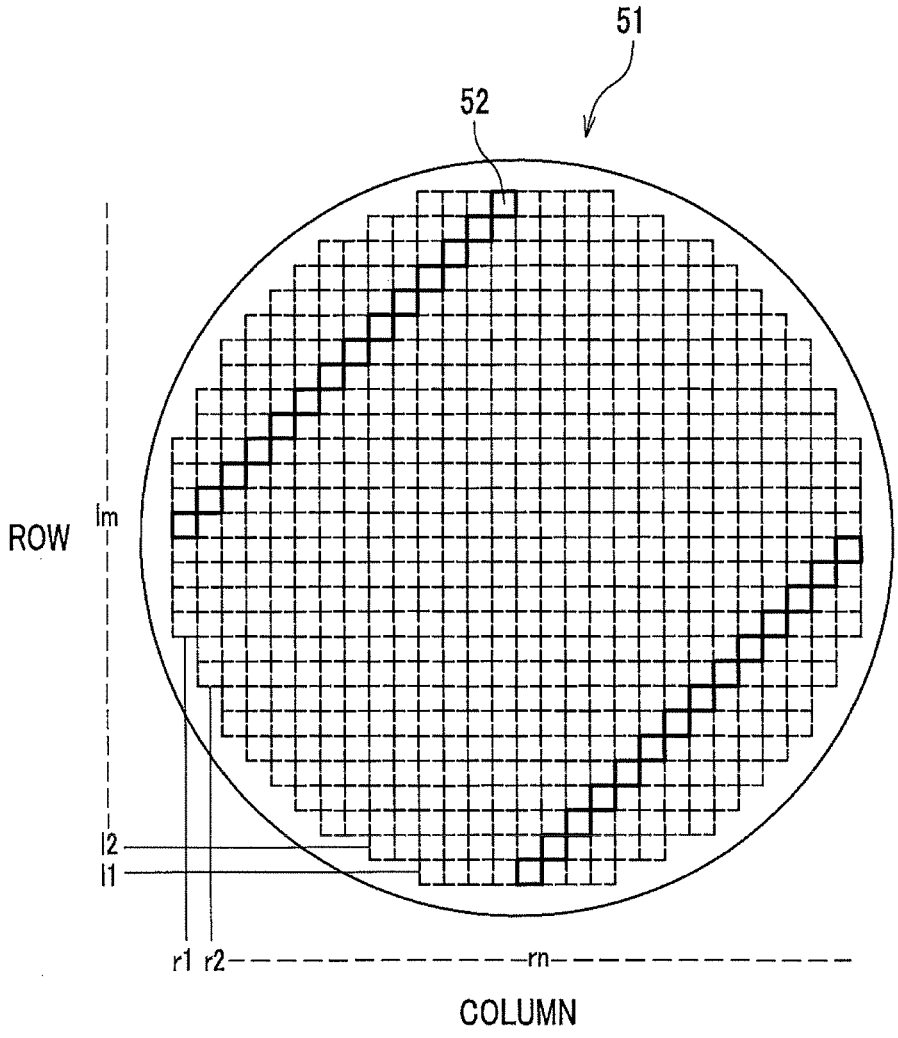


FIG.4

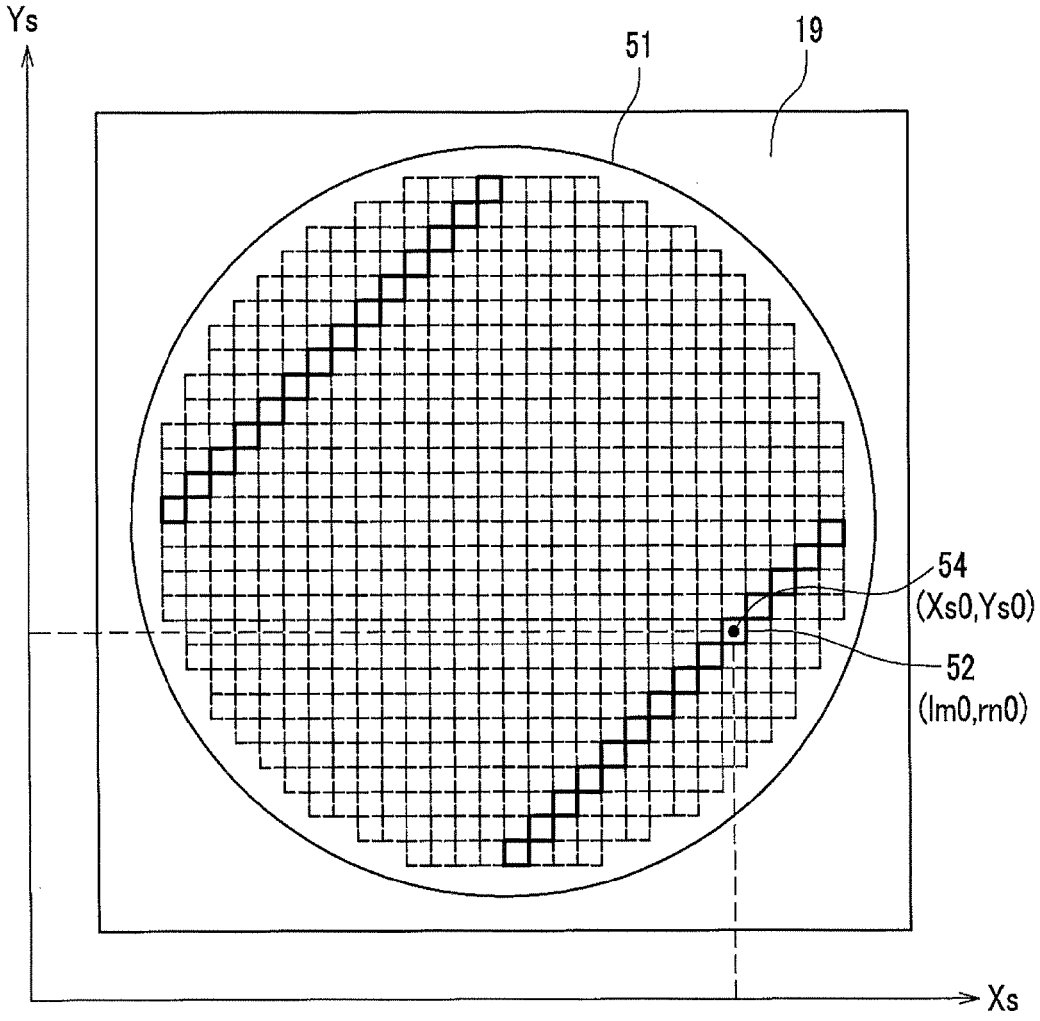


FIG.5

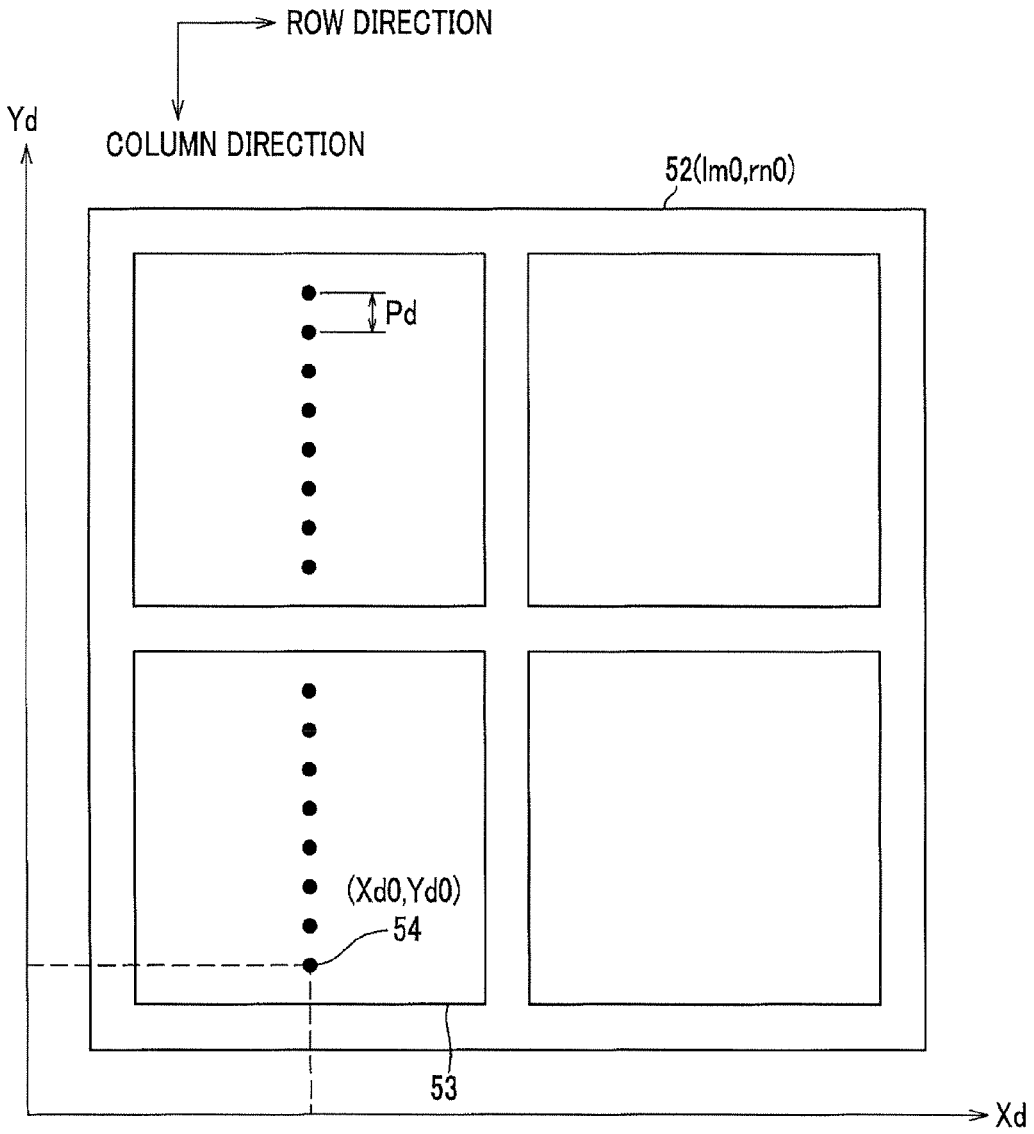

ROW DIRECTION
COLUMN DIRECTION
Yd
52(lm0,rn0)
Pd
(Xd0,Yd0)
54
53
Xd

FIG.6

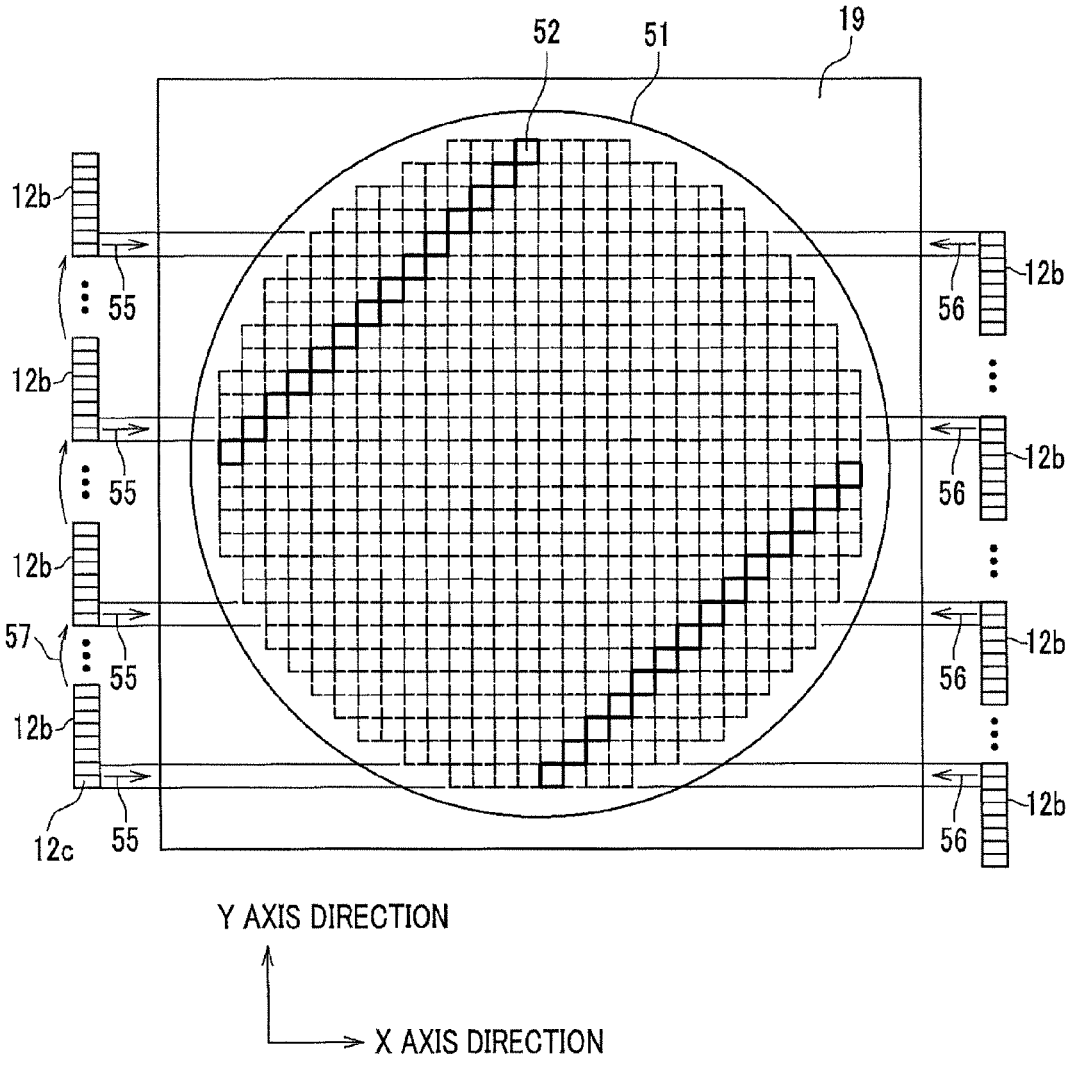


FIG.7

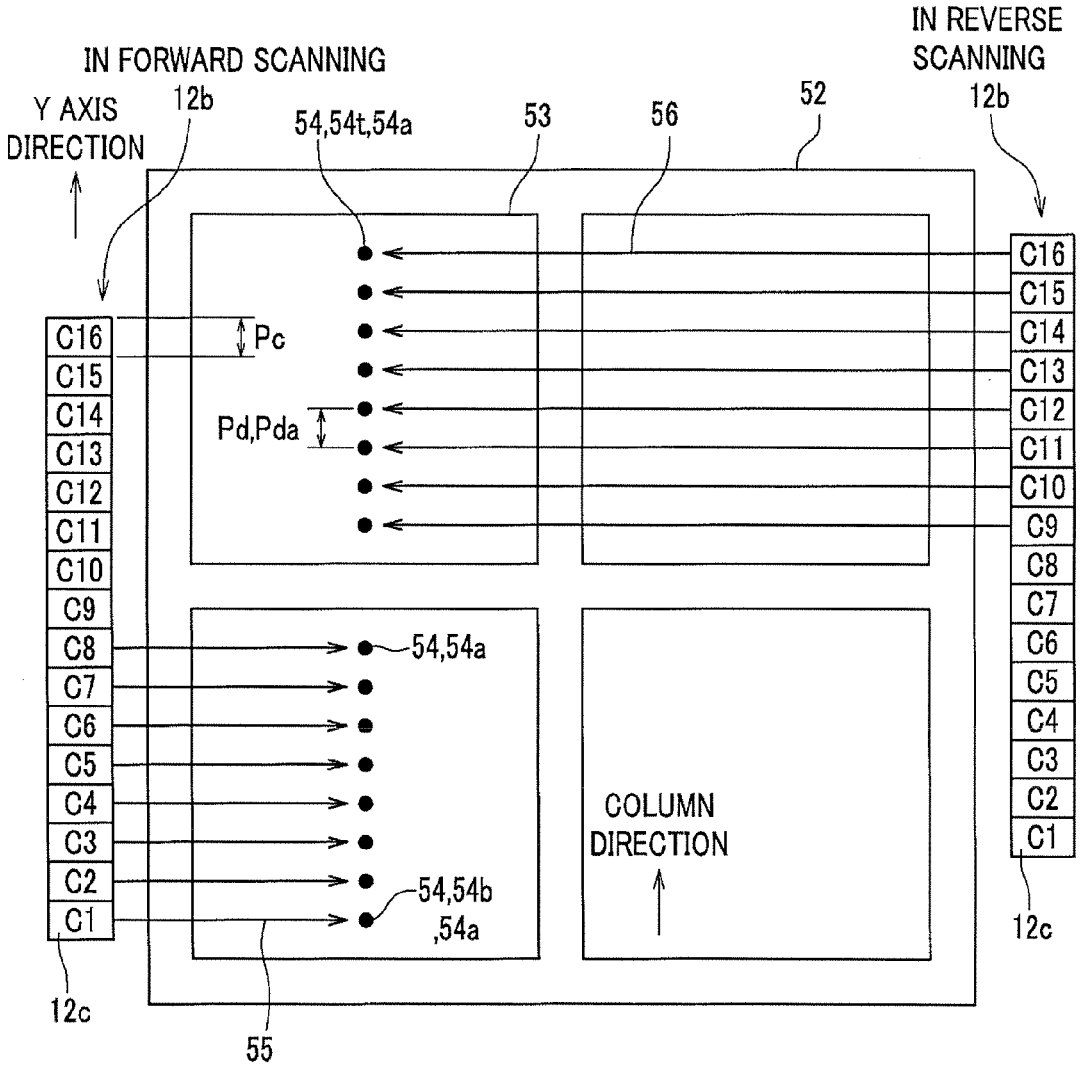

IN FORWARD SCANNING
IN REVERSE SCANNING
Y AXIS DIRECTION
12b
54,54t,54a
53
56
52
12b
C16
C15
C14
C13
C12
C11
C10
C9
C8
C7
C6
C5
C4
C3
C2
C1
Pc
Pd,Pda
54,54a
54,54b
,54a
COLUMN DIRECTION
12c
12c
55

FIG.8

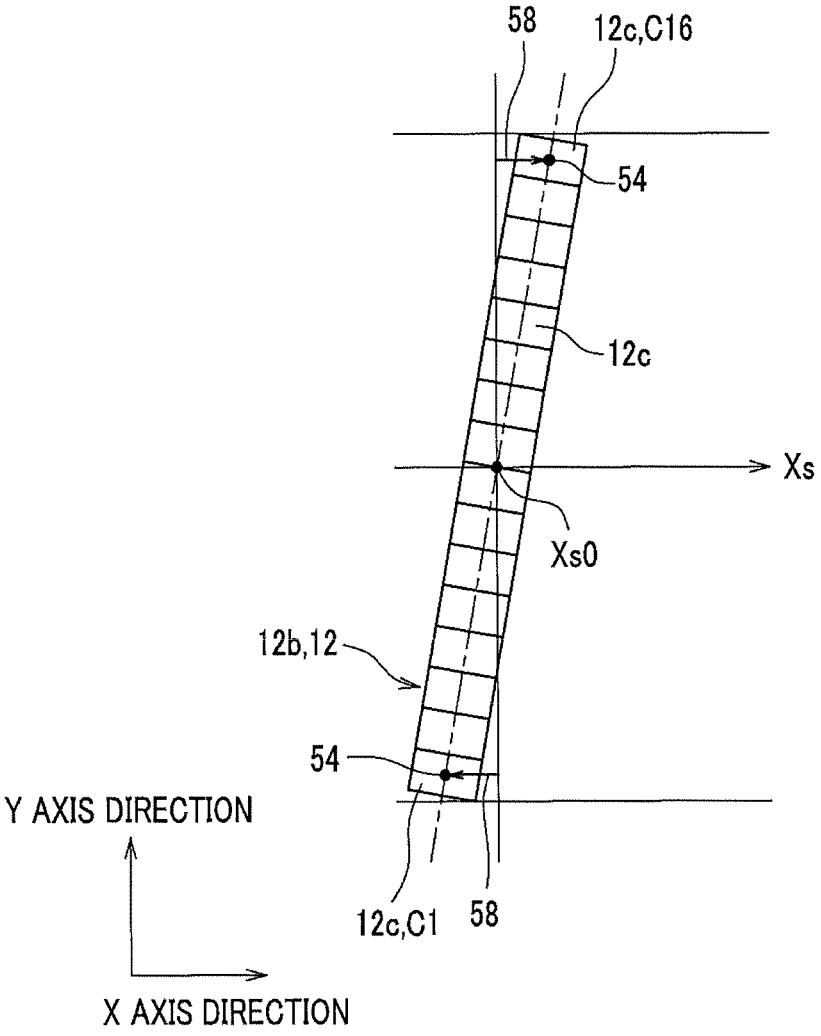

58
12c,C16
54
12c
Xs
Xs0
12b,12
54
Y AXIS DIRECTION
12c,C1
58
X AXIS DIRECTION

FIG.9A

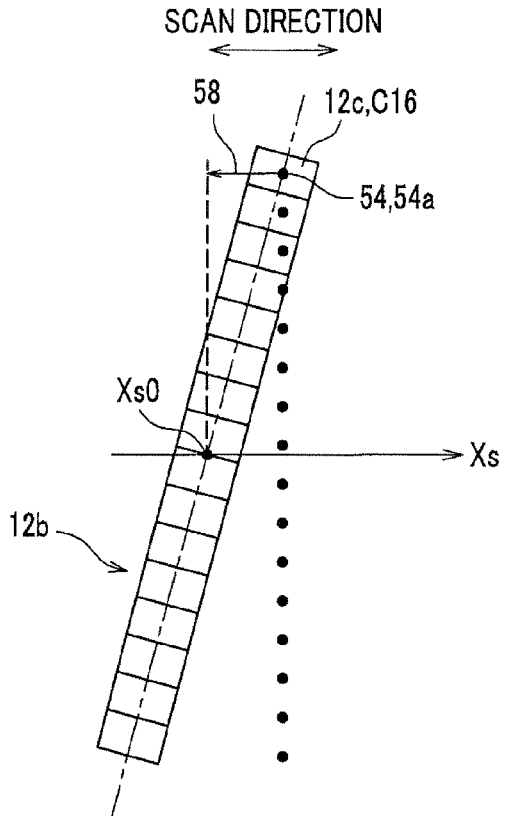

SCAN DIRECTION
58
12c,C16
54,54a
Xs0
Xs
12b

FIG.9B

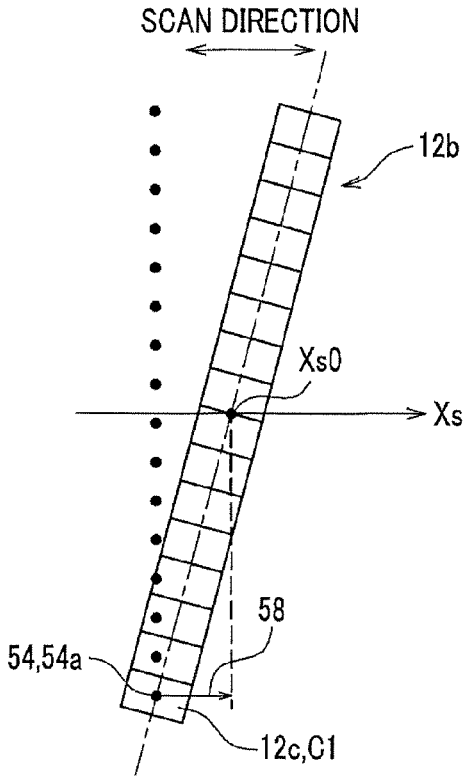

SCAN DIRECTION
12b
Xs0
Xs
58
54,54a
12c,C1

FIG.10

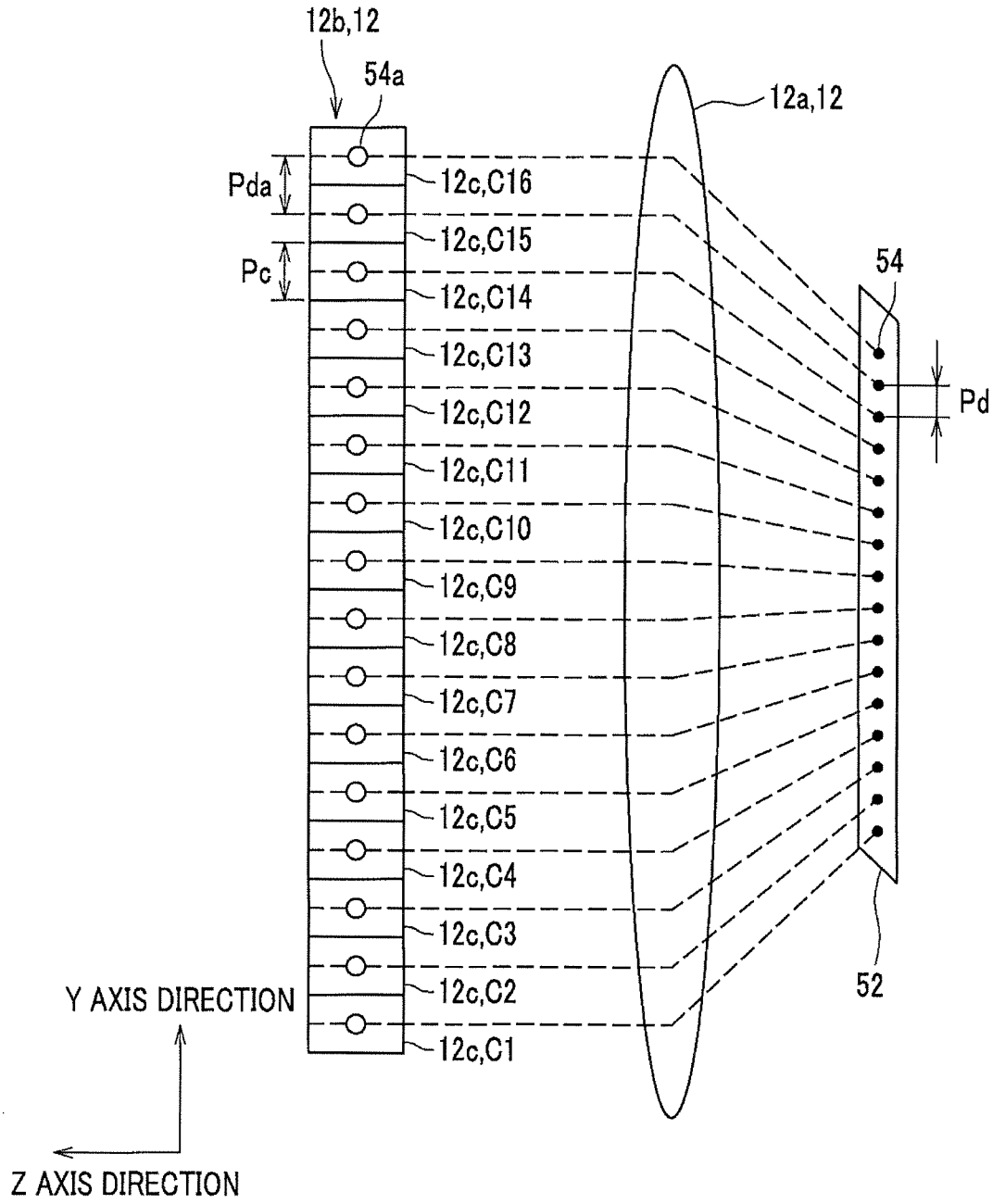

12b,12
54a
12a,12
Pda
Pc
12c,C16
12c,C15
12c,C14
12c,C13
12c,C12
12c,C11
12c,C10
12c,C9
12c,C8
12c,C7
12c,C6
12c,C5
12c,C4
12c,C3
12c,C2
12c,C1
54
Pd
52
Y AXIS DIRECTION
Z AXIS DIRECTION

FIG.11

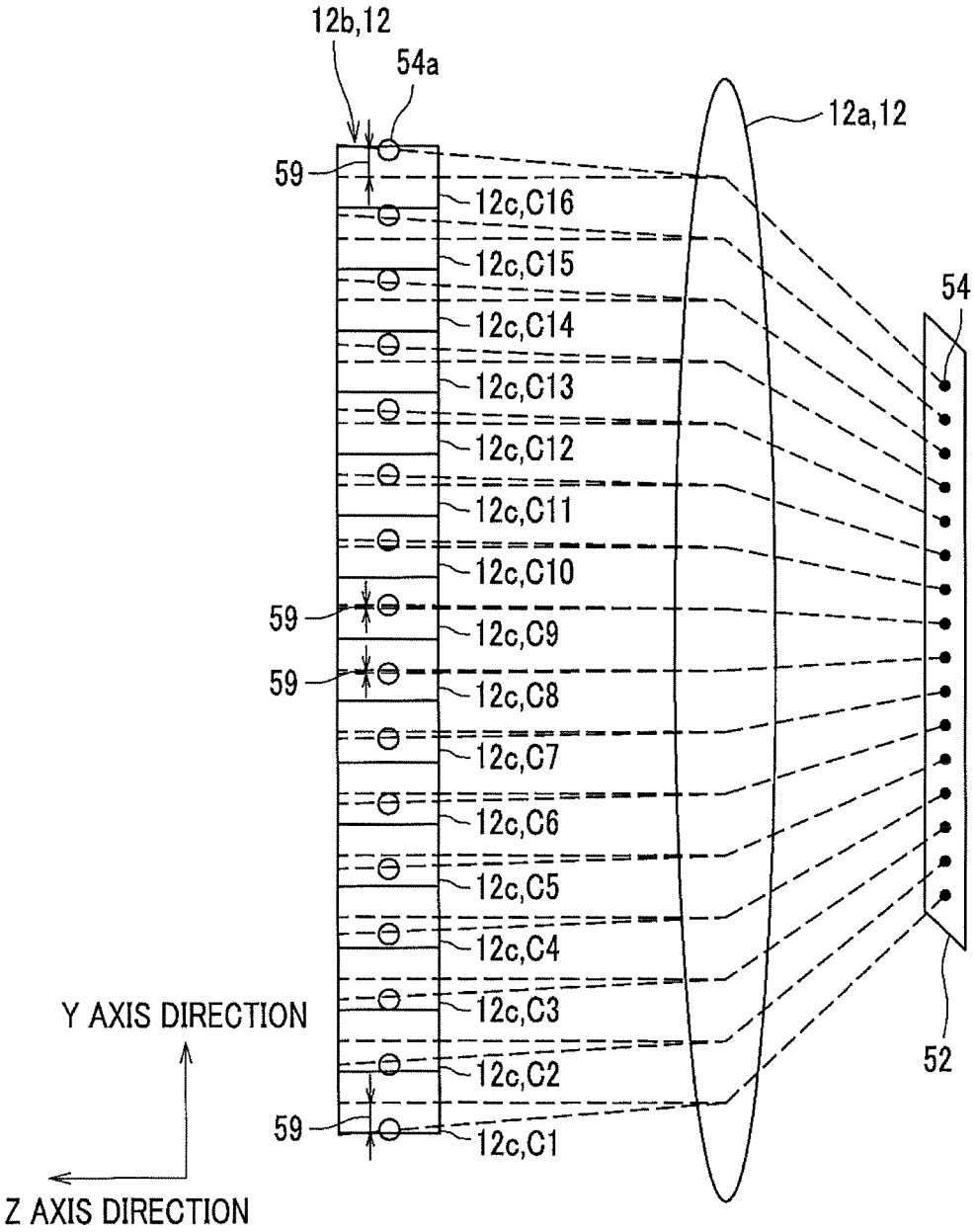

12b,12
54a
12a,12
59
12c,C16
12c,C15
54
12c,C14
12c,C13
12c,C12
12c,C11
12c,C10
59
12c,C9
59
12c,C8
12c,C7
12c,C6
12c,C5
12c,C4
Y AXIS DIRECTION
12c,C3
52
12c,C2
59
12c,C1
Z AXIS DIRECTION

FIG.12

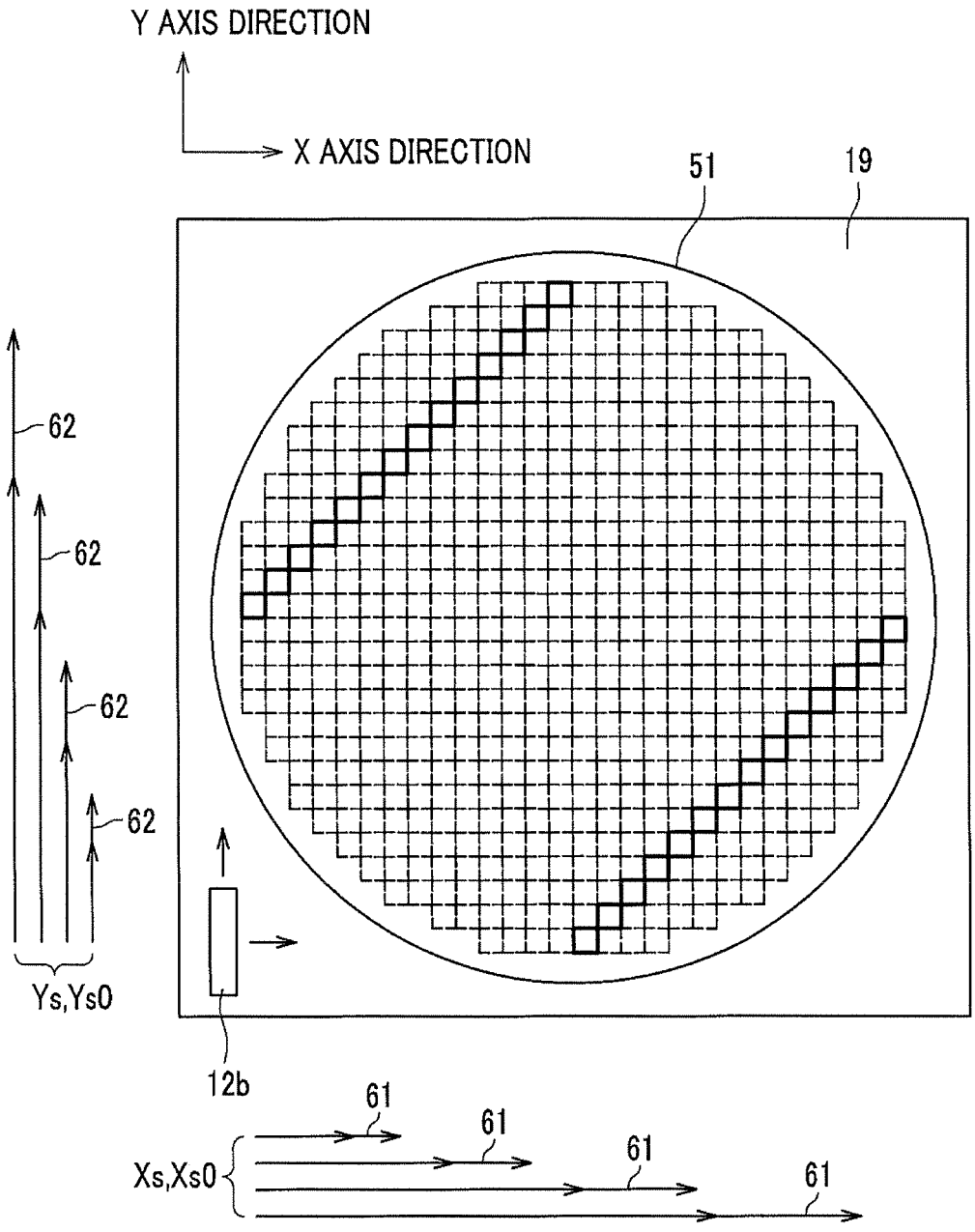

Y AXIS DIRECTION
X AXIS DIRECTION
51
19
62
62
62
62
Ys,Ys0
12b
61
61
61
61
Xs,Xs0

FIG.13

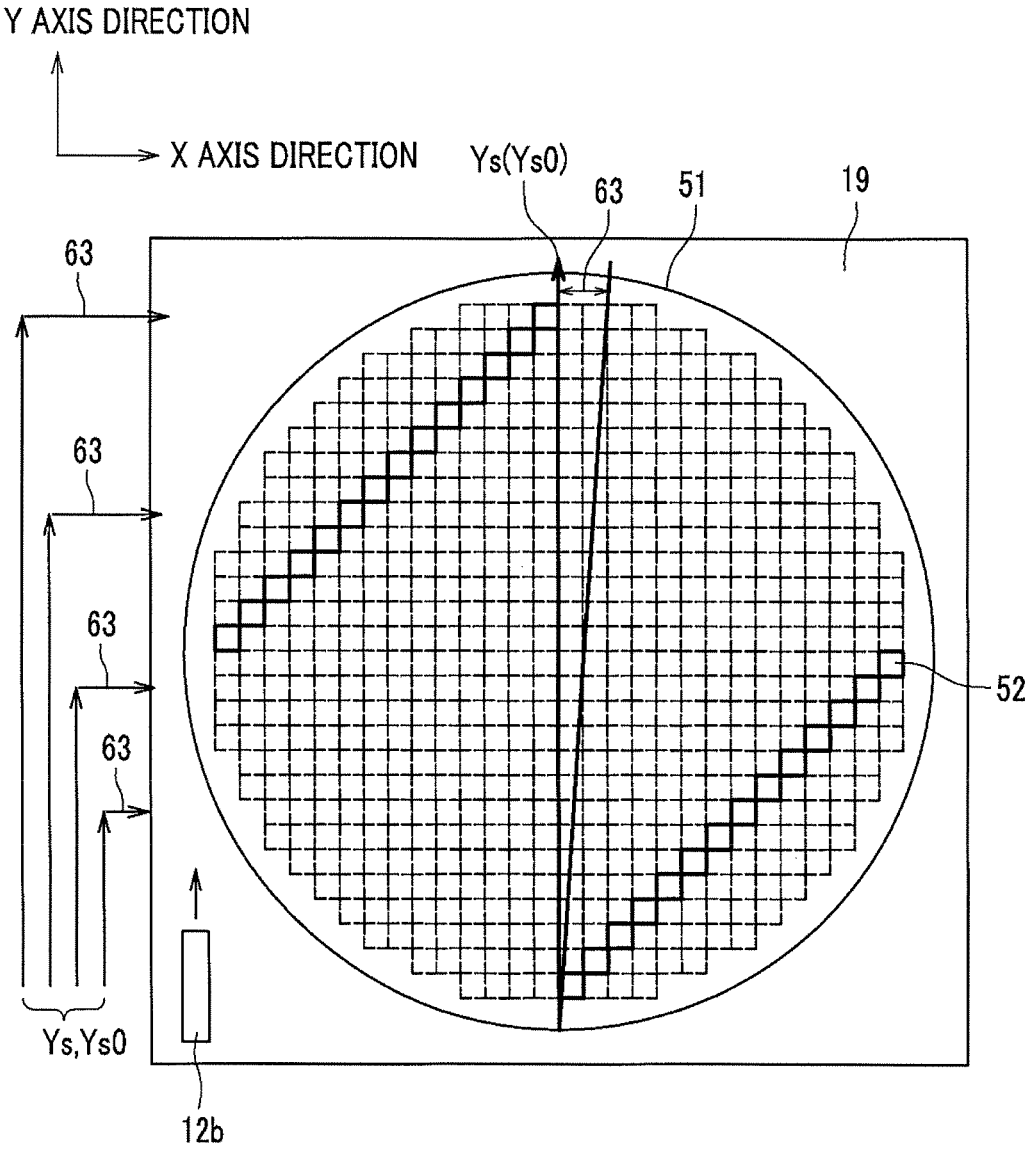

Y AXIS DIRECTION
X AXIS DIRECTION
Ys(Ys0)
63
51
19
63
63
63
63
52
Ys,Ys0
12b

FIG. 14

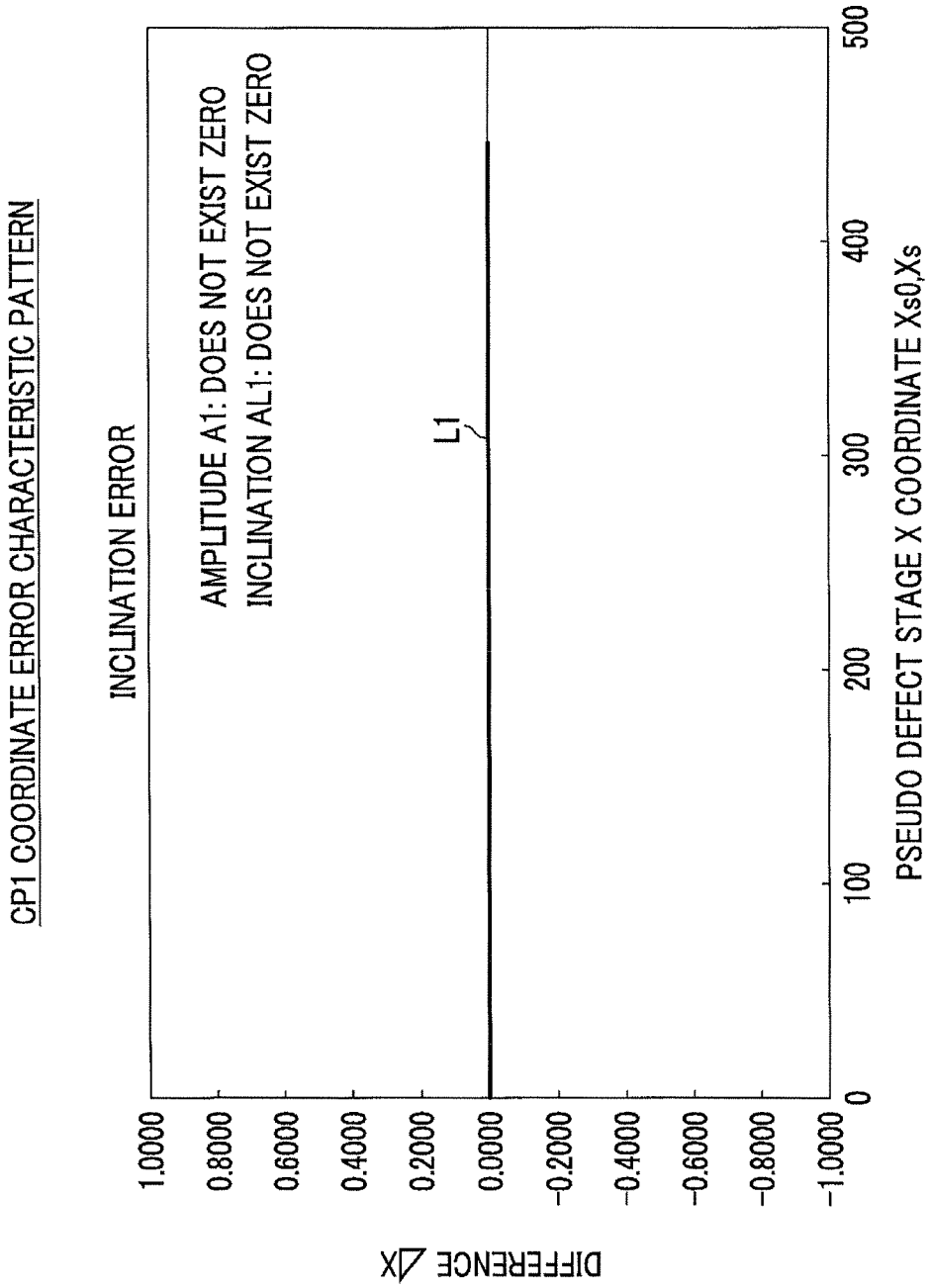

CP1 COORDINATE ERROR CHARACTERISTIC PATTERN
INCLINATION ERROR
AMPLITUDE A1: DOES NOT EXIST ZERO
INCLINATION AL1: DOES NOT EXIST ZERO
L1
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
-0.2000
-0.4000
-0.6000
-0.8000
-1.0000
0
100
200
300
400
500
DIFFERENCE ⊿X
PSEUDO DEFECT STAGE X COORDINATE Xs0,Xs

FIG.15

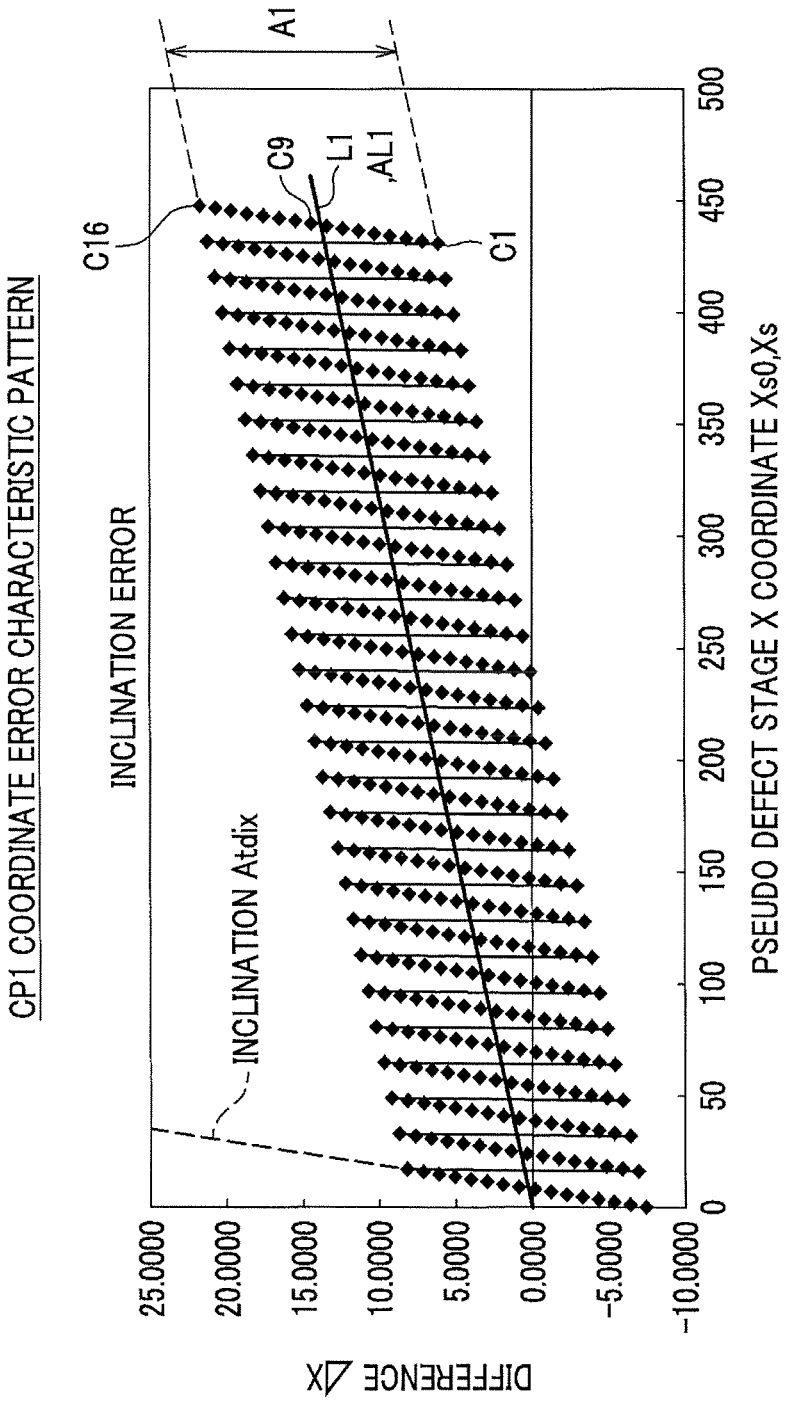

CP1 COORDINATE ERROR CHARACTERISTIC PATTERN
INCLINATION ERROR
INCLINATION Atdix
C16
C9
L1
AL1
C1
A1
DIFFERENCE ΔX
25.0000
20.0000
15.0000
10.0000
5.0000
0.0000
-5.0000
-10.0000
0
50
100
150
200
250
300
350
400
450
500
PSEUDO DEFECT STAGE X COORDINATE Xs0,Xs

FIG. 16

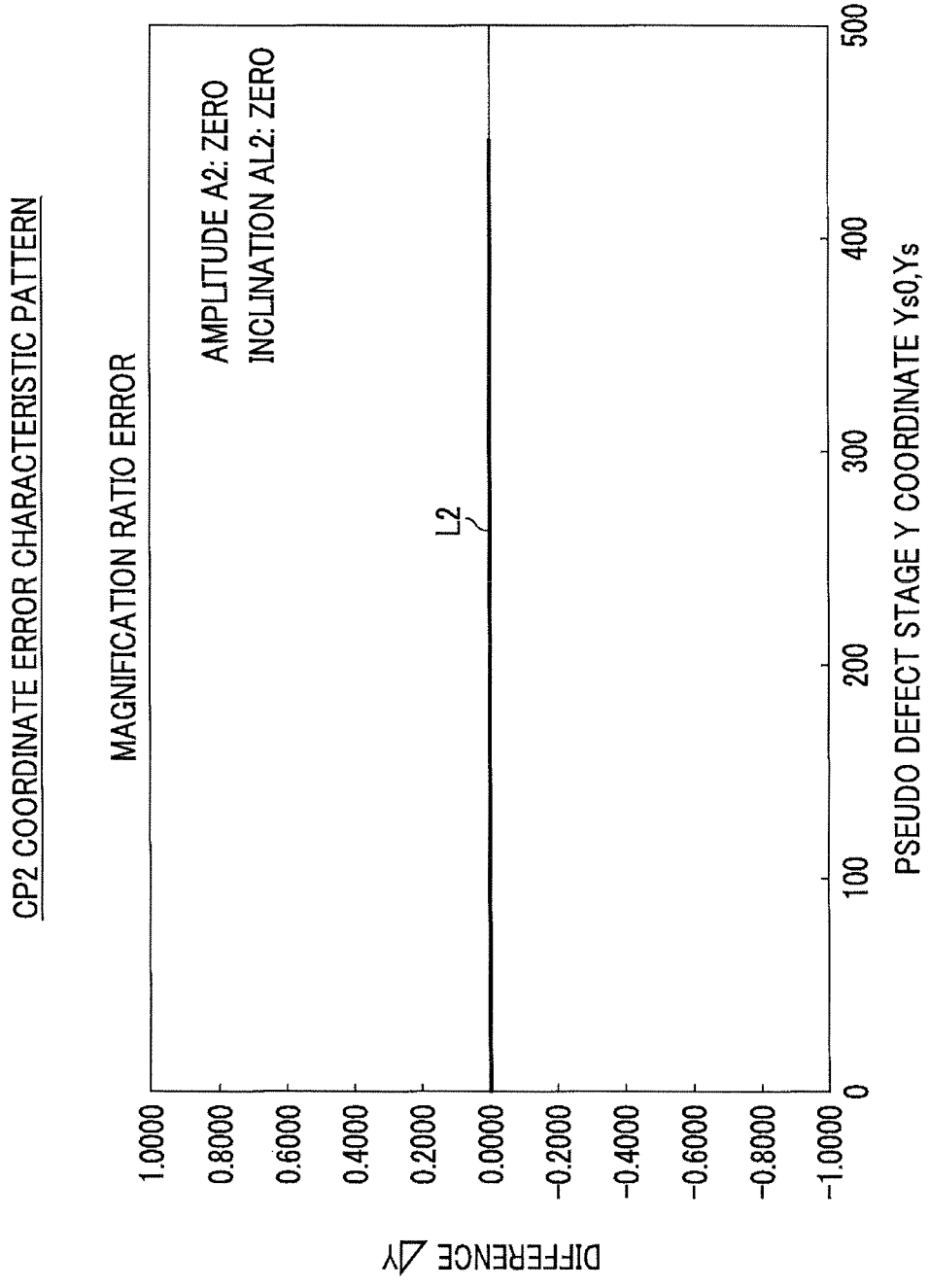

CP2 COORDINATE ERROR CHARACTERISTIC PATTERN
MAGNIFICATION RATIO ERROR
AMPLITUDE A2: ZERO
INCLINATION AL2: ZERO
L2
DIFFERENCE ΔY
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
-0.2000
-0.4000
-0.6000
-0.8000
-1.0000
0
100
200
300
400
500
PSEUDO DEFECT STAGE Y COORDINATE Ys0,Ys

FIG.17

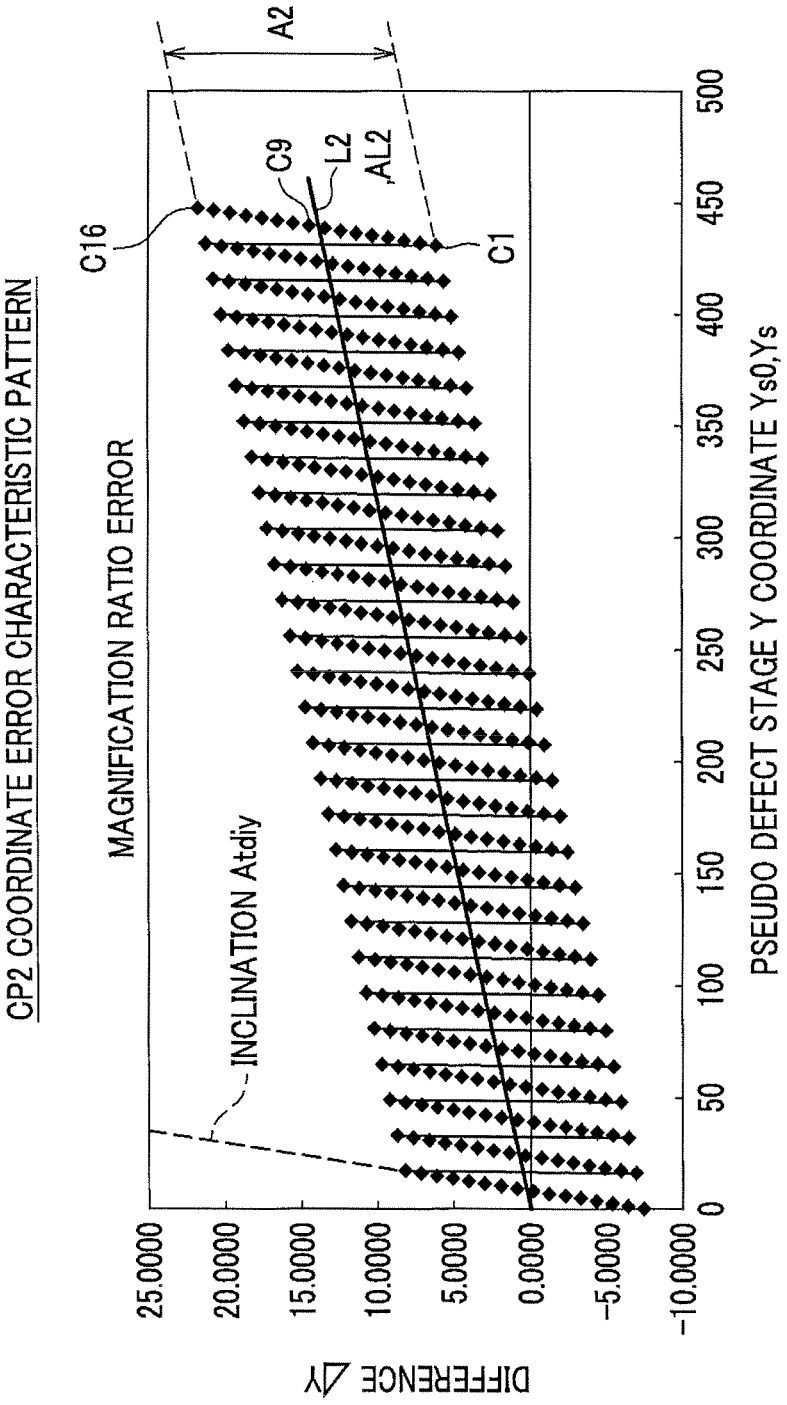

CP2 COORDINATE ERROR CHARACTERISTIC PATTERN
MAGNIFICATION RATIO ERROR
INCLINATION Atdiy
C16
C9
L2
AL2
C1
A2
DIFFERENCE ΔY
25.0000
20.0000
15.0000
10.0000
5.0000
0.0000
-5.0000
-10.0000
0
50
100
150
200
250
300
350
400
450
500
PSEUDO DEFECT STAGE Y COORDINATE Ys0,Ys

FIG.18

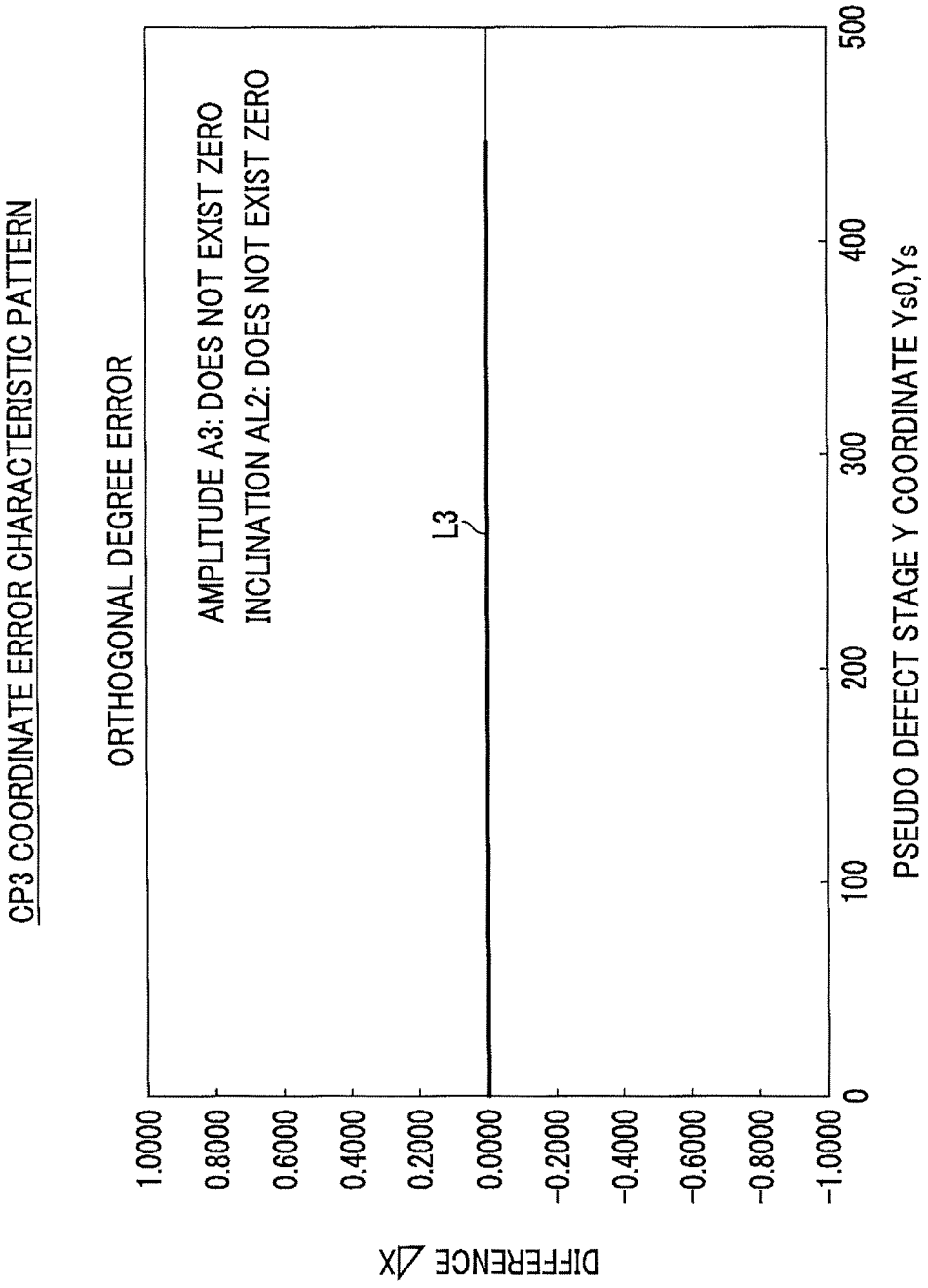

CP3 COORDINATE ERROR CHARACTERISTIC PATTERN
ORTHOGONAL DEGREE ERROR
AMPLITUDE A3: DOES NOT EXIST ZERO
INCLINATION AL2: DOES NOT EXIST ZERO
L3
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
-0.2000
-0.4000
-0.6000
-0.8000
-1.0000
DIFFERENCE ⊿X
0
100
200
300
400
500
PSEUDO DEFECT STAGE Y COORDINATE Ys0,Ys

FIG. 19

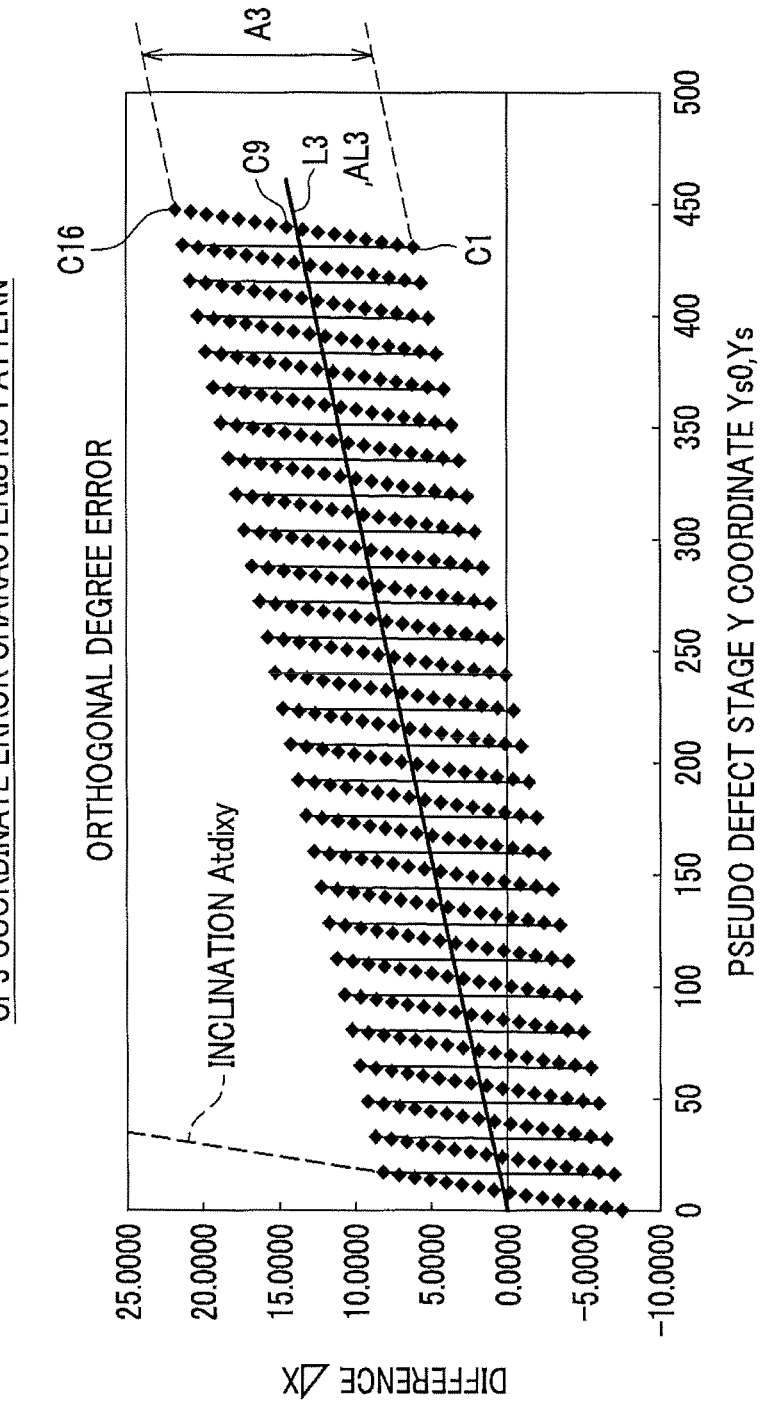

CP3 COORDINATE ERROR CHARACTERISTIC PATTERN
ORTHOGONAL DEGREE ERROR
INCLINATION Atdixy
C16
C9
L3
AL3
C1
A3
DIFFERENCE ⊿X
25.0000
20.0000
15.0000
10.0000
5.0000
0.0000
−5.0000
−10.0000
0
50
100
150
200
250
300
350
400
450
500
PSEUDO DEFECT STAGE Y COORDINATE Ys0,Ys

FIG.20

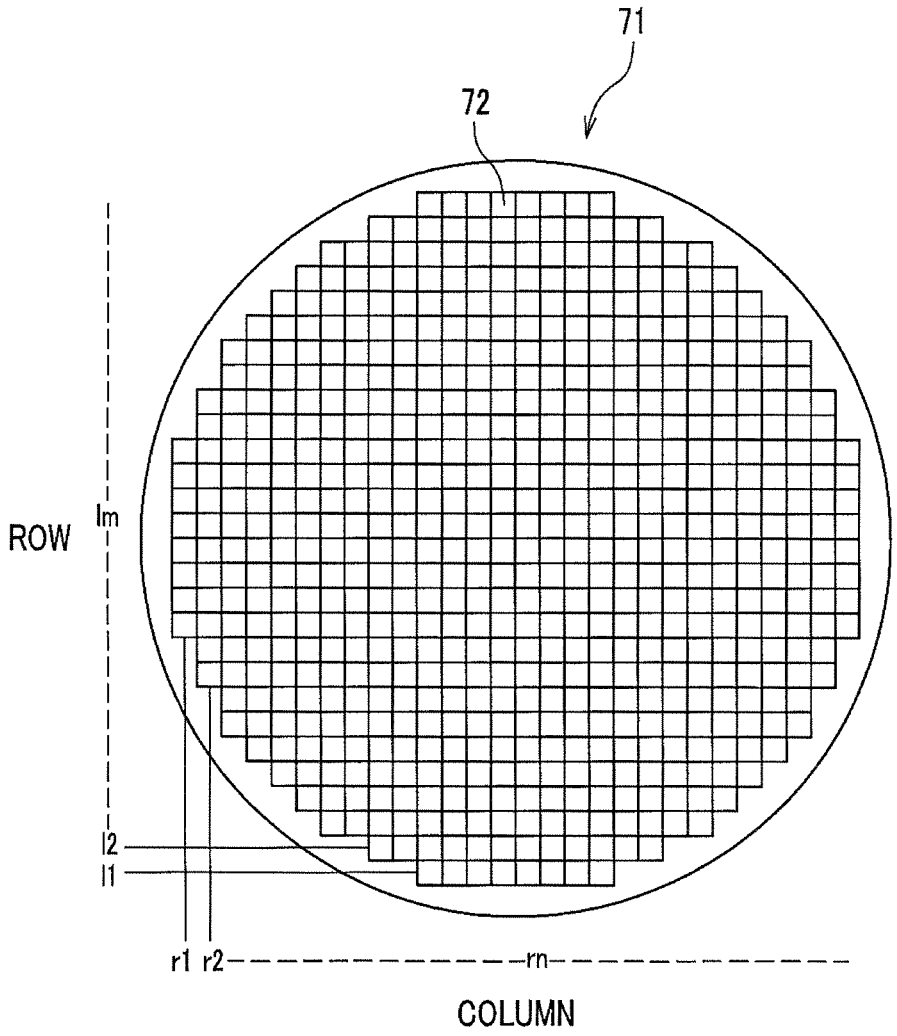


FIG.21

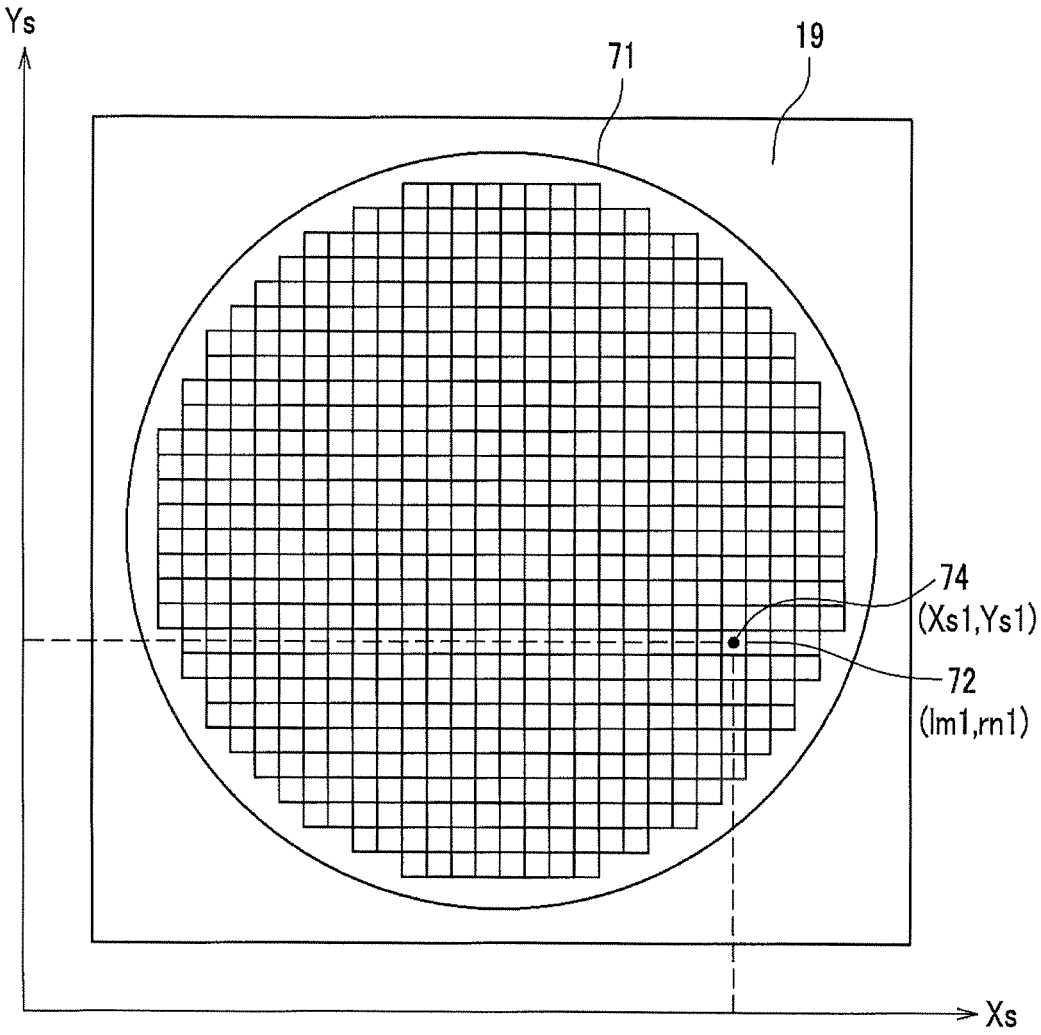


FIG.22

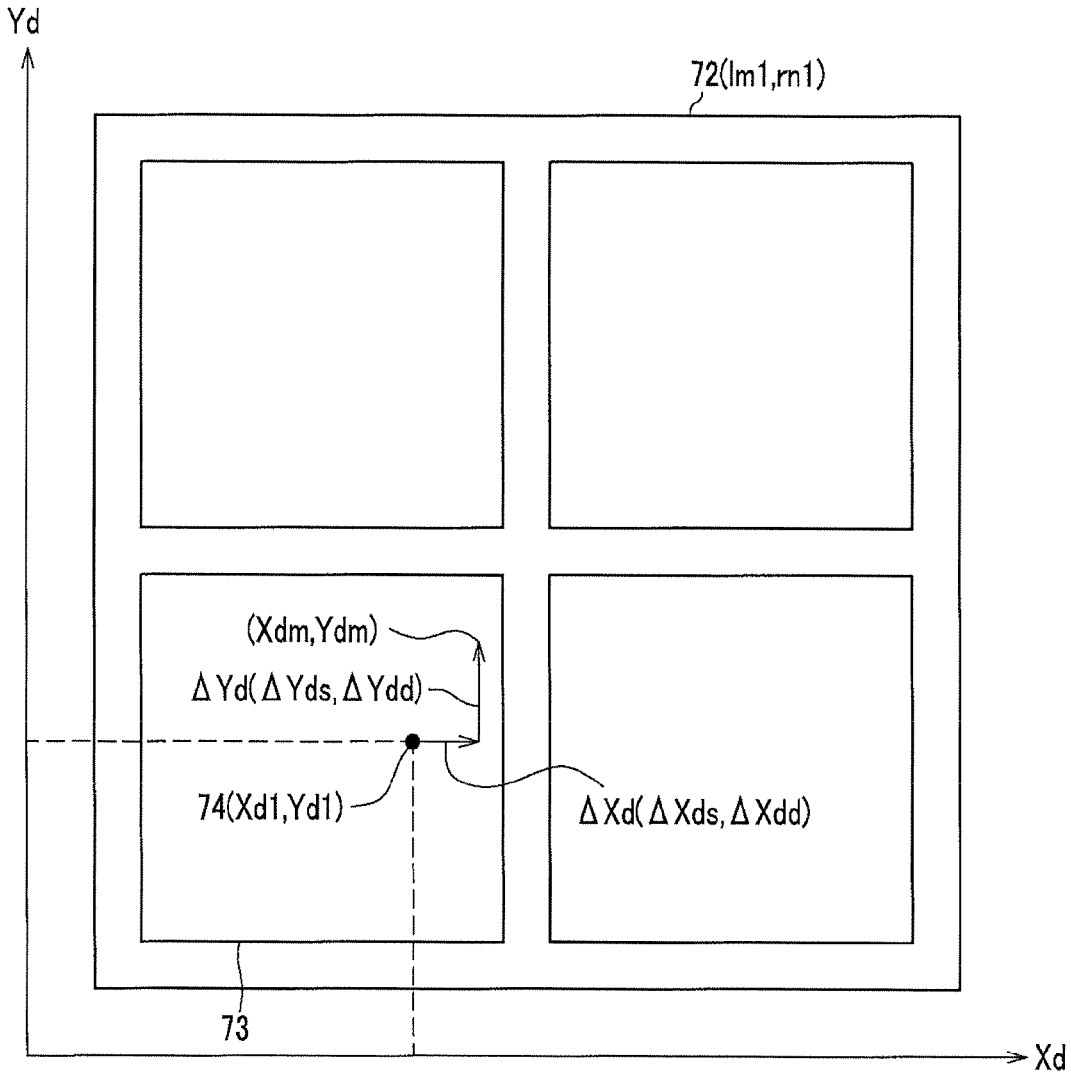

Yd
72(lm1,rn1)
(Xdm,Ydm)
ΔYd(ΔYds,ΔYdd)
74(Xd1,Yd1)
ΔXd(ΔXds,ΔXdd)
73
Xd

FIG.23

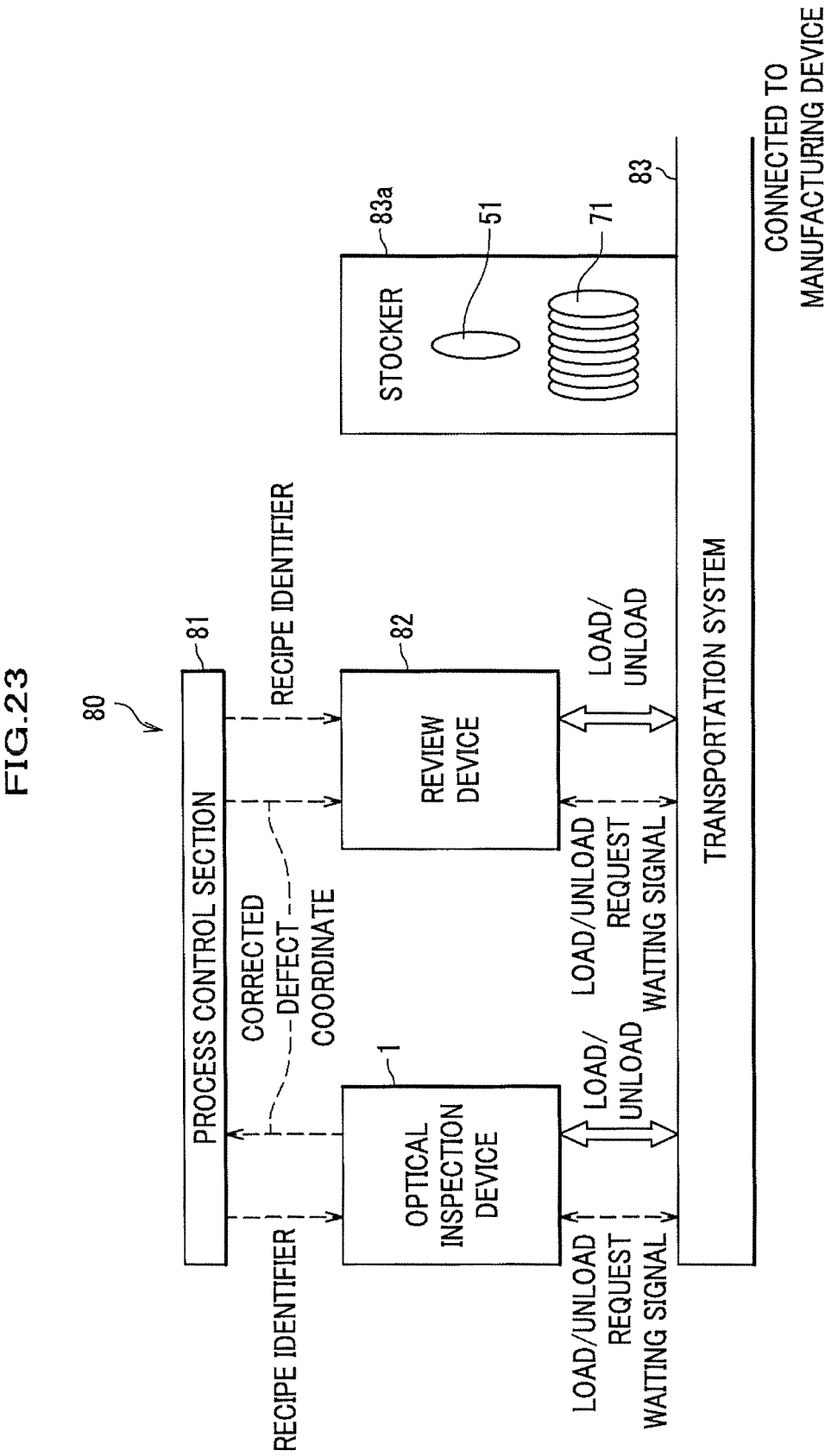

80
81
PROCESS CONTROL SECTION
RECIPE IDENTIFIER
CORRECTED DEFECT COORDINATE
RECIPE IDENTIFIER
1
OPTICAL INSPECTION DEVICE
82
REVIEW DEVICE
LOAD/ UNLOAD
LOAD/ UNLOAD
LOAD/UNLOAD REQUEST WAITING SIGNAL
LOAD/UNLOAD REQUEST WAITING SIGNAL
TRANSPORTATION SYSTEM
83
83a
STOCKER
51
71
CONNECTED TO MANUFACTURING DEVICE

FIG.24

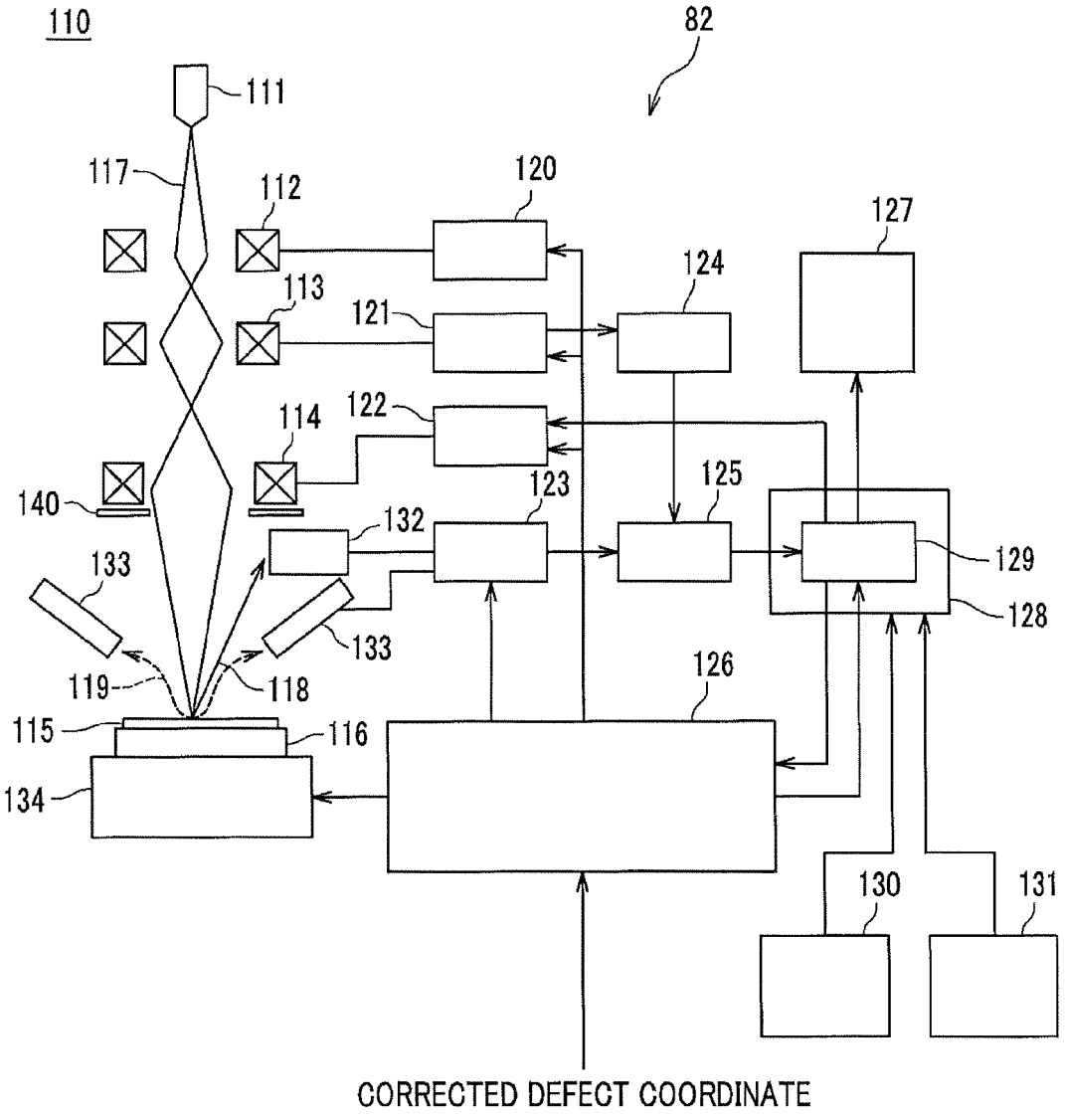
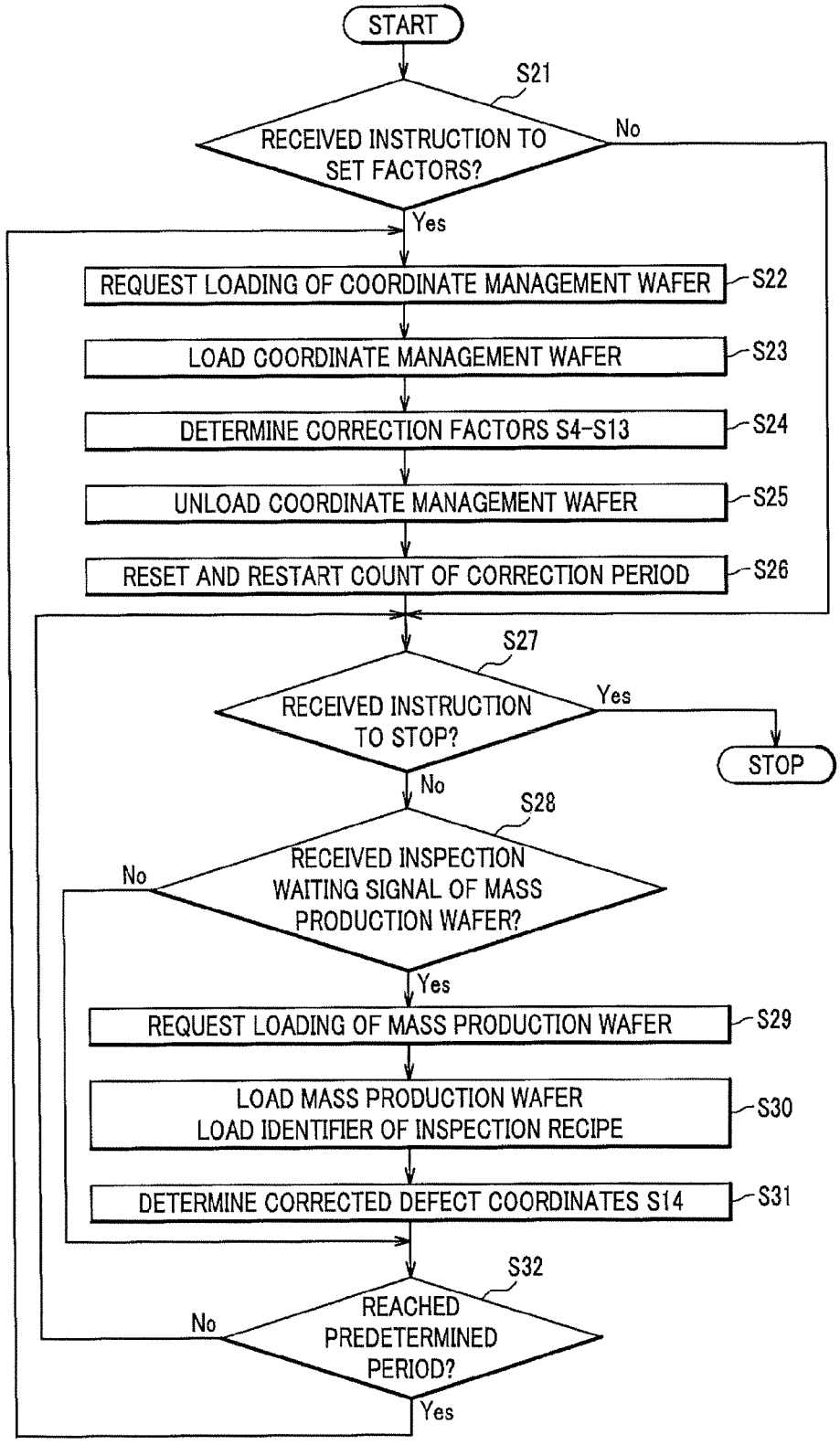

110
82
111
117
112
120
127
124
113
121
122
114
140
123
125
132
129
133
128
133
119
118
126
115
116
134
130
131
CORRECTED DEFECT COORDINATE

FIG.25


START
S21
RECEIVED INSTRUCTION TO SET FACTORS?
No
Yes
REQUEST LOADING OF COORDINATE MANAGEMENT WAFER
S22
LOAD COORDINATE MANAGEMENT WAFER
S23
DETERMINE CORRECTION FACTORS S4-S13
S24
UNLOAD COORDINATE MANAGEMENT WAFER
S25
RESET AND RESTART COUNT OF CORRECTION PERIOD
S26
S27
RECEIVED INSTRUCTION TO STOP?
Yes
STOP
No
S28
RECEIVED INSPECTION WAITING SIGNAL OF MASS PRODUCTION WAFER?
No
Yes
REQUEST LOADING OF MASS PRODUCTION WAFER
S29
LOAD MASS PRODUCTION WAFER
LOAD IDENTIFIER OF INSPECTION RECIPE
S30
DETERMINE CORRECTED DEFECT COORDINATES S14
S31
S32
REACHED PREDETERMINED PERIOD?
No
Yes

OPTICAL TYPE INSPECTION APPARATUS, INSPECTION SYSTEM AND THE WAFER FOR COORDINATES MANAGEMENT

RELATED APPLICATIONS

This application is the U.S. National Phase under 35 U.S.C. §371 of International Application No. PCT/JP2012/065972, filed on Jun. 22, 2012, which in turn claims the benefit of Japanese Application No. 2011-150140, filed on Jul. 6, 2011, the disclosures of which Applications are incorporated by reference herein.

TECHNICAL FIELD

The present invention relates to an optical type inspection apparatus, an inspection system including the same, and a wafer for coordinates management used for the same.

BACKGROUND ART

An optical type inspection apparatus is used for inspection of defects generated in a manufacturing process of a display device using a semiconductor device, liquid crystals and the like. Concretely, an optical type inspection apparatus finds defects and obtains the positions of the defects (defect coordinates). An optical type inspection apparatus is provided on an inspection system that is provided with a review device in addition to the optical type inspection apparatus. The review device displays with magnification the periphery of the position that a defect coordinate having been obtained by the optical type inspection apparatus represents, and can display with magnification the defect at the defect coordinate. A manufacturer of a semiconductor device or a display device can determine the cause of the generation of a defect by observing the defect that is displayed with magnification and reduce defects.

The structure of a semiconductor device or a display device is refined for high performance. Accordingly, it is considered that fine defects, which would not have conventionally caused a failure of a semiconductor device or a display device, may cause failures, and such fine defects have come to be an object of inspection by an optical type inspection apparatus. For the purpose of improving the inspection accuracy of an optical type inspection apparatus, a method of correcting the position deviation amount of a stage, on which a semiconductor device or a display device are mounted to be transported, is presented (see Patent Document 1, etc.)

RELATED ART DOCUMENT

Patent Documents

Patent Document 1: Japanese Patent Application Laid-Open No. 2009-10325

DISCLOSURE OF THE INVENTION

Problems to be Solved by the Invention

When defects as inspection objects have become fine, a review device comes to display these fine defects with magnification compared with conventional cases so that these fine defects can be easily observed. Accordingly, an area magnified for display becomes a narrow area only of the vicinity of a defect coordinate. It is considered that when an error is included in a defect coordinate obtained by an optical type inspection apparatus, even if the periphery of the defect coordinate is magnified, there is a case that the defect is not displayed on the display screen.

In this situation, an object to be attained by the present invention is to provide an optical type inspection apparatus capable of reducing error included in a defect coordinate, an inspection system provided with the optical type inspection apparatus, and a wafer for coordinates management used by the optical type inspection apparatus.

Means for Solving the Problem

According to the present invention, provided is an optical type inspection apparatus including a line sensor with plural channels capable of forming an image of a surface of a wafer, the channels being arrayed with equal intervals along Y axis direction, and a transporting unit that forms an image of an entire surface of the wafer on the channels by loading the wafer on a stage and repeatedly transporting, relatively to the line sensor, the wafer along X axis direction perpendicular to the Y axis direction, wherein the optical type inspection apparatus inspects the surface of the water, the optical type inspection apparatus including: a stage position detecting unit, wherein, when a wafer for coordinates management has been arranged such that: a matrix is set on the surface; one pseudo defect die is formed on each row of the matrix and one pseudo defect die is formed on each column of the matrix; and plural pseudo defects are formed in the each pseudo defect die in one array along a column direction with equal intervals such that a pitch between formed images, of the pseudo defects, on the channels is the same as a pitch between the channels, and if the wafer for coordinates management has been inspected as the wafer such that the Y axis direction and the column direction are substantially parallel to each other and an image of one pseudo defect is formed on the each channel, corresponding to the each pseudo defect die, then the stage position detecting unit detects a position, on the stage, of the each pseudo defect whose image has been formed on the corresponding channel, as a pseudo defect stage coordinate; a coordinate transforming unit that transforms the each detected pseudo defect stage coordinate into a pseudo defect die coordinate representing a position in the pseudo defect die that includes the pseudo defect; a difference computing unit that computes difference of the each pseudo defect die coordinate from a designed coordinate based on design, wherein the difference is generated when the pseudo defect is formed in the corresponding pseudo defect die; and a characteristic pattern obtaining unit that obtains at least either one of a coordinate error characteristic pattern in which the difference vibrates with a substantially constant amplitude with respect to the pseudo defect stage coordinate and a coordinate error characteristic pattern in which the difference increases or decreases along a line.

Further, according to the invention, provided is an inspection system including the above-described optical type inspection apparatus.

Still further, according to the invention, provided is a wafer for coordinates management, wherein a matrix is set on a surface of the wafer for coordinates management, wherein only one pseudo defect die is formed on each row of the matrix and only one pseudo defect die is formed on each column of the matrix, and wherein plural pseudo defects are formed on the each pseudo defect die with equal intervals only in one array along column direction of the matrix.

Advantages of the Invention

According to the present invention, it is possible to provide an optical type inspection apparatus capable of reducing error

included in a defect coordinate, an inspection system provided with the optical type inspection apparatus, and a wafer for coordinates management used by the optical type inspection apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1A to **1**C are configuration diagrams of an optical type inspection apparatus in an embodiment according to the present invention;

FIG. **2** is a flowchart of a method of correcting a defect coordinate, using the optical type inspection apparatus in the embodiment according to the present invention;

FIG. **3** is a plan view of a wafer for coordinates management in the embodiment according to the present invention;

FIG. **4** is a diagram for illustration of relationship between a stage coordinate and a pseudo defect stage coordinate on a wafer for coordinates management in the embodiment according to the present invention, wherein a wafer for coordinates management fixed on a stage is shown;

FIG. **5** is a diagram for illustration of the relationship between the die coordinate of a pseudo defect die formed on the wafer for coordinates management in the embodiment according to the present invention and a pseudo defect die coordinate, showing a plan view of the pseudo defect die;

FIG. **6** is a diagram for illustration of a method of scanning by a line sensor relative to a wafer for coordinates management;

FIG. **7** is a diagram showing the position relationship between formed images of pseudo defects (pseudo defect die) on channels and the channels during scanning;

FIG. **8** is a diagram for illustration of errors caused by inclination (inclination error) of a line sensor (No. 1: a diagram showing that a pseudo defect stage coordinate detected by channels C**1** and C**16** is Xs**0**);

FIG. **9**A is a diagram for illustration of inclination errors (No. 2: a diagram showing that a pseudo defect stage coordinate detected by the channel C**16** is Xs**0**);

FIG. **9**B is a diagram for illustration of inclination errors (No. 3: a diagram showing that a pseudo defect stage coordinate detected by the channel C**1** is Xs**0**);

FIG. **10** is a diagram for illustration of errors (magnification ratio errors) in forming images of pseudo defects onto a line sensor (No. 1: a case where magnification ratio errors exist);

FIG. **11** is a diagram for illustration of errors (magnification ratio errors) in forming images of pseudo defects onto a line sensor (No. 2: a case where magnification ratio error does not exist);

FIG. **12** is a diagram for illustration of errors in transportation amount of a stage (scale errors);

FIG. **13** is a diagram for illustration of errors caused by the orthogonal degree of the stage (orthogonal degree errors);

FIG. **14** shows a coordinate error characteristic pattern (No. 1: a case where error (difference) does not exist) representing the relationship of a difference ΔX from a pseudo defect stage coordinate Xs**0**;

FIG. **15** shows a coordinate error characteristic pattern (No. 2: a case where error (difference) exists) representing the relationship of a difference ΔX from a pseudo defect stage coordinate Xs**0**;

FIG. **16** shows a coordinate error characteristic pattern (No. 1: a case where error (difference) does not exist) representing the relationship of a difference ΔY from a pseudo defect stage coordinate Ys**0**;

FIG. **17** shows a coordinate error characteristic pattern (No. 2: a case where error (difference) exists) representing the relationship of a difference ΔY from a pseudo defect stage coordinate Ys**0**;

FIG. **18** shows a coordinate error characteristic pattern (No. 1: a case where error (difference) does not exist) representing the relationship of a difference ΔX from a pseudo defect stage coordinate Ys**0**;

FIG. **19** shows a coordinate error characteristic pattern (No. 2: a case where error (difference) exists) representing the relationship of a difference ΔX from a pseudo defect stage coordinate Ys**0**;

FIG. **20** is a plan view of a mass production wafer;

FIG. **21** is a diagram for illustration of the relationship between a stage coordinate and a real defect stage coordinate on a mass production wafer, and shows a mass production wafer fixed on a stage;

FIG. **22** is a diagram for illustration of the relationship between a die coordinate and a real defect die coordinate on a mass production die formed on a mass production wafer, and shows a plan view of a mass production die;

FIG. **23** is a configuration diagram of an inspection system in the embodiment according to the present invention;

FIG. **24** is a configuration diagram of a review device used for the inspection system in the embodiment according to the present invention; and

FIG. **25** is a flowchart of an operation method (a method of correcting defect coordinates) of the inspection system in the embodiment according to the present invention.

EMBODIMENT FOR CARRYING OUT THE INVENTION

An embodiment according to the present invention will be described below, referring to the drawings, as appropriate. Incidentally, in the drawings, the same reference symbols will be assigned to elements common to respective drawings, and overlapping description will be omitted.

FIGS. **1**A to **1**C are configuration diagrams of an optical type inspection apparatus **1** in an embodiment according to the present invention. The optical type inspection apparatus **1** includes an optical detection system (**11**, **12**, etc.) detecting defects and a focus control system (**15**, **16**, etc., a focus detection optical system + a focus drive system). During scanning of a wafer for coordinates management (wafer) **51**, it is possible to control the focus drive system of the focus control system (**15**, **16**, etc.) to the position of the focal point of the optical detection system (**11**, **12**, etc.) detected by the focus detection optical system of the focus control system (**15**, **16**, etc.) so as to follow the asperity (height) of the surface of the wafer for coordinates management **51**.

The optical type inspection apparatus **1** includes a lighting unit **11** of the optical detection system, a detection unit **12** (a photoreceptive unit **12***a*, an image forming unit (line sensor) **12***b*) of the optical detection system, a Y scale (stage position detection unit) **13**, an X scale (stage position detection unit) **14**, a lighting device **15** of the focus control (surface height position detection) system, a detector **16** (**16***a*, **16***b*, (Each one set is configured by two detectors.)) of the surface height position detection system, an image surface observing unit **17**, an image processing device **18**, a stage **19**, a transporting unit **19***a*, a processing device **21**, a stage control device **27**, and an image display device **28**.

The lighting unit **11** projects a laser light with a certain wavelength as an inspection light, and irradiates the surface of the wafer for coordinates management **51**, which is an inspection object, with the optical beam of the laser light.

The detection unit **12** (**12***a*, **12***b*) of the defect detection system receives an inspection light reflecting or scattering from the surface of the wafer for coordinates management **51**, and thereby detects an optical intensity.

The surface of the wafer for coordinates management **51** is provided with pseudo defect dies (chips) **52**. The wafer for coordinates management **51** is stuck to the stage **19**, and the stage **19** is transported in Y axis direction and X axis direction by the transporting unit **19***a* so that an inspection light projected from the lighting unit **11** scans the surface of the wafer for coordinates management (wafer) **51**. Thus, it is possible to make the inspection light scan the entire surface of the wafer for coordinates management **51**.

As the image forming unit (line sensor) **12***b* of the detection unit **12** of the defect detection system, for example, a TDI (Time Delay and Integration) sensor, a CCD (Charge Coupled Device) sensor, a photomultiplier, or the like can be used. The photoreceptive unit **12***a* of the detection unit **12** of the defect detection system forms an image on the image forming unit (line sensor) **12***b* by receiving/collecting a scattering light, of an inspection light, generated on the surface of the wafer for coordinates management **51**. Plural channels **12***c* are arrayed in Y axis direction on the image forming unit (line sensor) **12***b*. Positions, the positions being in respective channels **12***c*, where corresponding scattering lights of the inspection light have been formed can be specified individually for the respective channels **12***c*. The image forming unit (line sensor) **12***b* converts the formed images of the scattering lights of the inspection light into the intensities (electrical signals) of the scattering lights at the respective positions in Y axis direction, and outputs the electrical signals to the processing device **21** as image signals.

As the Y scale **13** and the X scale **14**, for example, laser scales or the like can be used. The Y scale **13** and the X scale **14** respectively detect the Y axis direction position (stage Y coordinate Ys) and the X axis direction position (stage X coordinate Xs) of the stage **19**, and output the position information to the processing device **21**. As described above, a wafer for coordinates management (wafer) **51** is mounted on the stage **19**, and the stage **19** is transported along Y axis direction and X axis direction by the transporting unit **19***a*. On the other hand, the optical path of the inspection light is not moved. Accordingly, the irradiation position of the wafer for coordinates management (wafer) **51** on the optical path of the inspection light can be associated with a set of the Y axis direction position (stage Y coordinate Ys) and the X axis direction position (stage X coordinate Xs) of the stage **19** one with one. That is, as the coordinate of an irradiation position, a Y axis direction position (stage Y coordinate Ys) and an X axis direction position (stage X coordinate Xs) of the stage **19** can be used. The stage Y coordinate Ys and the stage X coordinate Xs are transmitted to the coordinate management device (stage position detection unit) **25** of the processing device **21**.

The lighting device **15** of the surface height position detection system irradiates the wafer for coordinates management (wafer) **51**, which is an inspection object, with an inspection light for detecting a surface height position. The detector **16** (**16***a*, **16***b*) of the surface height position detection system detects the surface height position of the wafer for coordinates management (wafer) **51**. The detector **16** (**16***a*, **16***b*) includes two detectors **16***a*, **16***b*. These two detectors **16***a*, **16***b* have different detection central positions with respect to the upper/lower direction (Z axis direction) of an inspection object, and can detect (determine) the high/low relative to a predetermined height.

As the image surface observing unit **17**, a TTL (Through the Lens) method can be adopted, wherein, for example, a CCD sensor can be used. The image surface observing unit **17** receives a flattering light, of an inspection light, having passed through the photoreceptive unit **12***a* and been collected, and converts the intensity of the received light into an electrical signal. The converted electrical signal is output to the image processing device **18** as an image signal.

The processing device **21** includes an A/D convertor **22**, an image processing device **23**, a defect determination device **24**, a coordinate management device **25**, and an inspection result storage device **26**.

The A/D convertor **22** converts an image signal of an analog signal having been input from the image forming unit (line sensor) **12***b* into an image signal of a digital signal and outputs the converted image signal.

The image processing device **23** includes, for example, a delay circuit and a difference detection circuit. The delay circuit delays an image signal having been input from the A/D convertor **22**. The delay circuit outputs image signals of a chip on which irradiation with an inspection light has already been terminated, wherein the chip is immediately before a pseudo defect die (chip) **52** that is currently irradiated. The difference detection circuit detects a difference between an image signal of the pseudo defect die (chip) **52** which is currently irradiated with an inspection light, the image signal being directly input from the A/D convertor **22**, and an image signal, the signal being input via the delay circuit, of the chip on which irradiation with an inspection light has been terminated immediately before.

The defect determination device **24** inspects (determines) whether or not defect (pseudo defect) exists in a pseudo defect die currently irradiated with the inspection light, from the difference in image signal, the difference having been detected by the image processing device **23**. The defect determination device **24** includes a determination circuit **24***a* and factor tables (tables) **24***b* and **24***c*. The factor tables **24***b*, **24***c* store factors for changing a threshold value for defect determination, associating the factors with coordinate information. Coordinate information (stage Y coordinate Ys, stage X coordinate Xs) are input from a stage position detection unit (coordinate management device) **25**, and the factor tables **24***b*, **24***c* output factors stored in association with this coordinate information to the determination circuit **24***a*. A difference in image signal is input from the image processing device **23** to the determination circuit **24***a*, and factors for changing a threshold are input from the factor tables **24***b* and **24***c*. The determination circuit **24***a* multiplies a predetermined value by a factor for changing a threshold value, and thereby computes a threshold value. Then, the determination circuit **24***a* compares the difference in image signal and the threshold value, and if the difference in image signal is greater than or equal to the threshold value, the determination circuit **24***a* determines that there is a defect, and if the difference in image signal is smaller than the threshold value, the determination circuit **24***a* determines that there is no defect. This determination result is output to the inspection result storage device **26**. The determination circuit **24***a* outputs the information of the threshold value used for the determination to the inspection result storage device **26**.

The coordinate management device **25** determines the position (stage Y coordinate Ys and stage X coordinate Xs) where a light beam is currently projected, based on position information having been input from the Y scale **13** and the X scale **14**.

When the defect determination device **24** has determined that there is a defect, the inspection result storage device **26**

stores the coordinate information (stage Y coordinate Ys and stage X coordinate Xs) having been input from the coordinate management device **25** as pseudo defect stage coordinate (pseudo defect stage Y coordinate Ys**0** and pseudo defect stage X coordinate Xs**0**). The inspection result storage device **26** stores information of the value having been input from the defect determination device **24**, associating the information with the coordinate information.

The stage control device **27** controls the transporting unit **19***a*, thereby transports the stage **19** upward or downward (transports along Z axis direction), and thus sets the focal point of the optical system of the detection unit **12** onto the surface of the wafer for coordinates management **51**. Further, the stage control device **27** controls the transporting unit **19***a*, thereby transports the stage **19** along X axis direction and Y axis direction, and thus makes an inspection light scan the entire surface of the wafer for coordinates management **51**.

The processing device **21** includes a coordinate transforming unit **31**, a difference computing unit **32**, a characteristic pattern obtaining unit **33**, an inclination obtaining unit **34**, an amplitude obtaining unit **35**, a stage correction factor computing unit **36**, a cannel correction factor computing unit **37**, a stage correction amount computing unit **38**, a die correction amount computing unit **39**, a die coordinate correcting unit **40**, a storing/transmitting unit **41**, and a timer **42**. The functions of the respective units will be described in the description of a method of correcting defect coordinate using the later-described optical type inspection apparatus **1**.

FIG. **2** shows a flowchart of a method of correcting defect coordinate, using the optical type inspection apparatus **1** in the embodiment according to the present invention.

First, in step S**1**, an operator or the like of the optical type inspection apparatus **1** prepares a wafer for coordinates management **51**. FIG. **3** is a plan view of the prepared wafer for coordinates management **51**. A matrix is set on the surface of the wafer for coordinates management **51**. In the matrix, plural rows l**1**, l**2**, . . . , lm, . . . are set, and plural columns r**1**, r**2**, . . . rn, . . . are set. One pseudo defect die **52** is formed on each line l**1**, l**2**, . . . , lm, ... Likewise, one pseudo defect die **52** is formed on each column on each column r**1**, r**2**, . . . rn, ...

FIG. **4** shows the wafer for coordinates management **51** fixed on the stage **19**. Pseudo defect dies **52** are formed on the wafer for coordinates management **51**, and pseudo defects **54** are formed in the pseudo defect dies **52**. Incidentally, although plural pseudo defects **54** are formed in a pseudo defect die **52**, only one pseudo defect **54** is shown in a certain pseudo defect die **52** for easy understanding in FIG. **4**. When rows and columns are set on the wafer for coordinates management **51**, a position (lm**0**, rn**0**) of a pseudo defect die **52** can be defined by setting a certain row lm**0** and a certain column rn**0**. Based on a designed coordinate (on the die coordinate) in the pseudo defect die **52** and the position (lm**0**, rn**0**) of the pseudo defect die **52**, it is possible to determine the position forming a pseudo defect **54**, and form the pseudo defect **54**. Incidentally, as described later, a pseudo defect **54** formed in such a manner is determined to be a defect by the defect determination device **24** in FIGS. **1**A to **1**C, and the pseudo detect stage coordinate (the pseudo detect stage Y coordinate Ys**0** and the pseudo defect stage X coordinate Xs**0**) is stored in the inspection result storage device **26**, as a position where the pseudo defect **54** is located on the stage coordinate (stage Y coordinate Ys and the stage X coordinate Xs).

FIG. **5** shows a plan view of a pseudo defect dies **52**. Die cells **53** are formed in the pseudo defect die **52**. In the example in FIG. **5**, die cells **53**, totally four in two vertical and horizontal rows, are formed. In the die cells **53**, plural (totally 16 defects, in the example in FIG. **5**, eight for each) pseudo defects **54** are formed. Plural pseudo defects **54** are disposed on one column in the column direction (Y axis direction) of the matrix. Further, the plural pseudo defects **54** are formed such as to have equal intervals of pitch Pd. That is, design is made such that the die X coordinates Xd are equal to each other among plural pseudo defects **54** on the die coordinate (die Y coordinate Ys and die X coordinate Xd), which is the coordinate in the pseudo defect die **52**. Further, the die Y coordinates Yd of the designed coordinate are designed such as to have a constant interval (pitch Pd) between adjacent pseudo defects **54**. Incidentally, as shown in FIG. **4**, the stage coordinates (stage Y coordinate Ys and stage X coordinates Xs) of the formed pseudo defects **54** are stored in the inspection result storage device **26** as pseudo defect stage coordinates (pseudo defect stage Y coordinate Ys**0** and pseudo defect stage X coordinate Xs**0**). Such a pseudo defect stage coordinate (pseudo defect stage Y coordinate Ys**0** and pseudo defect stage X coordinate Xs**0**) can be transferred with one to one relationship into a pseudo defect die coordinate (pseudo defect die X coordinate Xd**0** and pseudo defect die Y coordinate Yd**0**) in the die coordinate (die Y coordinate Yd and die X coordinate Xd). If the pseudo defect stage coordinate (pseudo defect stage Y coordinate Ys**0** and pseudo defect stage X coordinate Xs**0**) includes an error, it means that the transferred pseudo defect die coordinate (pseudo defect die X coordinate Xd**0** and pseudo defect die Y coordinate Yd**0**) also includes an error, and does not agree with the above-described designed coordinate, which causes a difference. In the present embodiment, as the difference can be used to correct the defect coordinate of a real defect, a defect coordinate can be obtained with high accuracy.

Returning to FIG. **2**, in step S**2** in FIG. **2**, the operator (the manufacturer of semiconductor devices or display devices) of the optical type inspection apparatus **1** creates a scan table (inspection recipe) used in using the wafer for coordinates management **51**. By the scan table, a scan method (scan path along Y axis direction and X axis direction) of the inspection light onto the wafer for coordinates management **51** is determined. The scan table refers to a buffer that stores in advance a moving path for moving the transporting unit **19***a* by the stage control device **27**, as the scan path. Incidentally, in scanning with the inspection light, as the position relationship between the optical path of the inspection light and the line sensor **12***b* is unchanged, it is also possible to consider that the line sensor **12***b* performs this scanning.

FIG. **6** shows a method of relative scanning of the wafer for coordinates management **51** by the line sensor **12***b*. In case that the line sensor **12***b* performs so-called forward scanning **55** that is scanning along X axis direction from the left to the right in FIG. **6**, the line sensor **12***b* scans, setting the lowermost portion with respect to Y axis direction of the line sensor **12***b* in FIG. **6** to the lowermost portion with respect to Y axis direction of the pseudo defect die **52** in FIG. **6**. In case that the line sensor **12***b* performs so-called reverse scanning **56** that is scanning along X axis direction from the right to the left in FIG. **6**, the line sensor **12***b* scans, setting the uppermost portion with respect to Y axis direction of the line sensor **12***b* in FIG. **6** to the uppermost portion with respect to Y axis direction of the pseudo defect die **52** in FIG. **6**. The forward scanning **55** and the reverse scanning **56** are performed on every row where a pseudo defect die (chips) **52** is arranged. By moving up a row for performing the forward scanning **55** and the reverse scanning **56** one by one to an upper row in FIG. **6**, it is possible to scan all pseudo defect dies **52** on the wafer for coordinates management **51** by the line sensor **12***b*. Incidentally, it is not necessarily required to perform both the

forward scanning **55** and the reverse scanning **56**, and either one may be performed. Further, rows for performing the forward scanning **55** and rows for performing the reverse scanning **56** may be set. Still further, as the wafer for coordinates management **51** is in a circular shape, chipping off may occur on some pseudo defect dies **52** formed at the outer circumferential portion of the wafer for coordinates management **51**. Pseudo defects **54**, on the upper side or the lower side of FIG. **5**, of these pseudo defect dies **52** may be lost by this chipping off. The scan table is produced such that scanning is not performed above pseudo defect dies (incomplete dies) **52** whose pseudo defects **54** are totally or partially missing.

FIG. **7** shows the position relationship between formed images, of pseudo defects **54**, on channels **12***c* and the channels **12***c* during scanning. In the present embodiment, as errors in position coordinates of pseudo defects **54** are taken as the problem, it is necessary to accurately detect the pseudo defect stage coordinates (pseudo defect stage Y coordinate Ys**0** and pseudo defect stage X coordinate Xs**0**) of the pseudo defects **54**. Accordingly, design is made such that the formed images **54***a* of pseudo defects **54** on channels **12***c* are generated at the centers of the width along Y axis direction of the respective channels **12***c*. In order that the formed images **54***a* of pseudo defects **54** on channels **12***c* are generated at the centers of the width along Y axis direction of plural respective channels **12***c*, it is necessary to make the pitch Pda of the formed images **54***a*, on the channels **12***c*, of the pseudo defects **54** equal to the pitch Pc of the channels **12***c* (Pda=Pc). The pitch Pd of pseudo defects **54** is designed such as to satisfy this condition in preparing the wafer for coordinates management **51** in step S**1** in FIG. **2**.

However, as shown in FIG. **7**, there is a case that, between die cells **53** (between the eighth and ninth pseudo defects **54** from the bottom), a pitch Pd between pseudo defects **54** is different from other pitches Pd. In such a case, for forward scanning, by arranging the channel **12***c* (C**1**) at the lower end in FIG. **7** and the formed image **54***a* of the pseudo defect **54***b* at the lower end at the same position, it is possible to recognize the formed images **54***a* of pseudo defects **54**, at the centers of the width along Y axis direction of the channels **12***c* (C**1**-C**8**). However, it is understood that the formed images **54***a* of pseudo defects **54** cannot necessarily be recognized at the centers of the width along Y axis direction of the channels **12***c* (C**9**-C**16**) due to the deviation of pitch Pd.

On the other hand, for reverse scanning, by arranging the channel **12***c* (C**16**) at the upper end in FIG. **7** and the formed image **54***a* of the pseudo defect **54***t* at the upper end at the same position, it is possible to recognize the formed images **54***a* of pseudo defects **54**, at the centers of the width along Y axis direction of the channels **12***c* (C**9**-C**16**). However, it is understood that the formed images **54***a* of pseudo defects **54** cannot necessarily be recognized at the centers along the width along Y axis direction of the channels **12***c* (C**1**-C**8**) due to the deviation of pitch Pd.

In this situation, by recognizing the formed images **54***a* of pseudo defects **54** by the channels **12***c* (C**1**-C**8**) in forward scanning and recognizing the formed images **54***a* of pseudo defects **54** by the channels **12***c* (C**9**-C**16**) in reverse scanning, it is possible to recognize the formed images **54***a* of all the pseudo defects **54** at the centers of the width along Y axis direction of the channels **12***c* (C**1**-C**16**). Accordingly, a scan table is set such that the channels **12***c* (C**1**-C**8**) are valid and the channels **12***c* (C**9**-C**16**) are invalid for forward scanning. The scan table is set such that the channels **12***c* (C**9**-C**16**) are valid and the channels **12***c* (C**1**-C**8**) are invalid for reverse scanning. Incidentally, FIG. **7** shows a case that two die cells **53** are arranged along Y axis direction of the pseudo defect die **52**. In case that three or more die cells **53** are arranged, the scan table can be set such that the formed images **54***a* of the pseudo defects **54** in the die cell **53** located at the lower end of these die cells **53** are recognized at the centers of the width along Y axis direction of the channels **12***c* (C**1**-C**16**) in forward scanning, and the formed images **54***a* of the pseudo defects **54** in the die cell **53** located at the upper end of these die cells **53** are recognized at the centers of the width along Y axis direction of the channels **12***c* (C**1**-C**16**) in reverse scanning. According to these, on a column of pseudo defects **54** in a pseudo defect die **52**, the pseudo defect **54***b* and the pseudo defect **54***t* located at the both ends can be recognized at the centers of the width along Y axis direction of the channels C**1** and C**16** (**12***c*).

Subsequently, returning to FIG. **2**, in step S**3** in FIG. **2**, the processing device **21** or the stage control device **27** of the optical type inspection apparatus **1**, or the operator determines whether or not a created scan table is applicable. Concretely, by performing inspection, using the created scan table, it is determined whether or not all pseudo defect dies **52** in the wafer for coordinates management **51** can be inspected. Further, by performing inspection, using the created scan table, it is determined whether or not pseudo defects **54** can be detected by all channels **12***c* in the line sensor **12***b*. If the scan table has been determined applicable (step S**3**, Yes), the process proceeds to step S**4**, and if determined inapplicable (step S**3**, No), the process returns to step S**2**.

Subsequently, in step S**4**, the optical type inspection apparatus **1** performs inspection of the entire surface of the wafer for coordinates management **51**, using the scan table created in step S**2**. In the inspection of the entire surface, first, a later-described correction factor is initialized to be set to zero. Thus, it is possible to obtain a defect coordinate including an error without correcting the defect coordinate. All pseudo defects **54** in the wafer for coordinates management **51** and the pseudo defect dies **52** are detected, and the pseudo defect stage coordinates (pseudo defect stage X coordinate Xs**0**, pseudo defect state Y coordinate Ys**0**) of positions, where these pseudo defects **54** have been detected, are detected by the scale position detecting units (Y scale, X scale, and coordinate management device) **13**, **14**, and **25** (see FIGS. **1**A to **1**C). The coordinate transforming unit **31** (see FIGS. **1**A to **1**C) transforms the detected pseudo defect stage coordinates (pseudo defect stage X coordinate Xs**0**, pseudo defect state Y coordinate Ys**0**) into pseudo defect die coordinates (pseudo defect die X coordinate Xd**0**, pseudo defect die Y coordinate Yd**0**) representing the positions in the pseudo defect dies **52** in which corresponding pseudo defects **54** are included. The storing/transmitting unit **41** (see FIGS. **1**A to **1**C) stores the pseudo defect stage coordinates (pseudo defect stage X coordinate Xs**0**, pseudo defect stage Y coordinate Ys**0**) and the pseudo defect die coordinates (pseudo defect die X coordinate Xd**0**, pseudo defect die Y coordinate Yd**0**).

Subsequently, in step S**5**, the difference computing unit **32** (see FIGS. **1**A to **1**C) computes differences ΔX (=Xd**0**−Xd**2**), ΔY (=Yd**0**−Yd**2**) of the pseudo defect die coordinates (pseudo defect die X coordinate Xd**0**, pseudo defect die Y coordinate Yd**0**) from designed coordinates (designed X coordinate Xd**2**, designed Y coordinate Yd**2**) which are based on design, wherein the differences ΔX and ΔY are generated when the pseudo defects **54** are formed in the pseudo defect dies **52**.

Then, in step S**6**, the characteristic pattern obtaining unit **33** (see FIGS. **1**A to **1**C) obtains and displays coordinate error characteristic patterns. Before describing the coordinate error characteristic patterns, five kinds of errors that can be

detected using the coordinate error characteristic patterns and decrease the accuracy of a defect coordinate, which are (1) inclination error, (2) magnification ratio error, (3) X scale error, (4) Y scale error, and (5) orthogonal degree error, will be described.

(1) Inclination Error

Using FIG. **8**, FIG. **9**A, and **9**B, an inclination error **58**, which is generated by inclination of the line sensor **12***b*, will be described. In FIG. **8**, ideally, the line sensor **12***b* should be disposed such that the array direction of the channels **12***c* is parallel to Y axis direction, however, the array direction of the channels **12***c* is inclined from Y axis direction by an assembling error or a temporal change, to cause inclination errors **58**. Concretely, it is assumed that the line sensor **12***b* is scanning along X axis direction relative to pseudo defects **54** (the wafer for coordinates management **51** (see FIGS. **1**A to **1**C)). As shown in FIG. **8** and FIG. **9**A, when a pseudo defect **54** (the formed image **54***a* of a pseudo defect) is detected by the channel **12***c* (C**16**), a pseudo defect stage coordinate Xs**0** is detected with respect to stage X coordinate Xs, as the position of the pseudo defect **54**. That is, it is recognized that an inclination error **58** is generated as an error at the position (stage X coordinate Xs) of the pseudo defect **54**. Further, it is recognized that the outer on the line sensor **12***b*, the larger the inclination error **58**. FIG. **8** and FIG. **9**B show that a pseudo defect **54** (the formed image **54***a* of a pseudo defect) is detected by the channel **12***c* (C**1**). As the stage X coordinate Xs then of the pseudo defect **54** is detected to be a pseudo defect stage coordinate Xs**0**, it is recognized that an inclination error **58** is generated. Inclination errors **58** are generated in X axis direction.

(2) Magnification Ratio Error

Using FIG. **10** and FIG. **11**, a magnification ratio error **59** generated on a formed image **54***a*, of a pseudo defect **54**, formed on the line sensor **12***b* will be described. As shown in FIG. **10**, as the photoreceptive unit **12***a* (see FIGS. **1**A to **1**C) functions as a collective lens, pseudo defects **54** formed on a pseudo defect die **52** are ideally formed (**54***a*) at the centers of the channels **12***c* (C**1**-C**16**) of the line sensor **12***b*, and magnification ratio errors **59** (see FIG. **11**) are not generated. This is because the pitch Pd of pseudo defects **54** is designed such that the pitch Pc of the channels **12***c* becomes equal to the pitch Pda of the formed images **54***a* of pseudo defects **54** (Pc =Pda) in producing a wafer for coordinates management in step S**1** in FIG. **2**.

FIG. **11** shows a case that magnification ratio errors **59** are generated. For example, if the distances between the pseudo defect die **52** (pseudo defects **54**), the photoreceptive unit **12***a*, and the line sensor **12***b* change, the magnification ratio of the formed images **54***a* of the pseudo defects **54** changes. The formed images **54***a* of the pseudo defects **54** deviate from the centers of the channels **12***c* (C**1**-C**16**) of the line sensor **12***b* to generate the magnification ratio errors **59**. The magnification ratio errors **59** are generated along Y axis direction, differently from the case of inclination errors **58**. It is recognized that the outer on the line sensor **12***b*, the larger the magnification ratio error **59**.

(3) X Scale Error

Using FIG. **12**, X scale errors **61**, which are errors in transportation amount along X axis direction of the stage **19**, will be described. A transportation amount along X axis direction is a relative movement amount between the line sensor **12***b* and the stage **19**. An X scale error **61** is generated on a transportation amount (from the coordinate origin) along X axis direction of the stage **19**, namely, a stage X coordinate Xs (pseudo defect stage X coordinate Xs**0**). An X scale error **61** is generated along X axis direction. The larger the transportation amount (stage X coordinate Xs (pseudo defect stage X coordinate Xs**0**)) along X axis direction of the stage **19** (from the coordinate origin), the larger the X scale error **61**. Incidentally, there are cases where an X scale error **61** is generated in a direction that increases a stage X coordinate Xs (pseudo defect stage X coordinate Xs**0**) (increases a transportation amount), and there are also cases where an X scale error **61** is generated in an opposite direction that decreases a stage X coordinate Xs.

(4) Y Scale Error

Using FIG. **12**, Y scale errors **62**, which are errors in transportation amount along Y axis direction of the stage **19**, will be described. A transportation amount along Y axis direction is a relative movement amount between the line sensor **12***b* and the stage **19**. AY scale error **62** is generated on a transportation amount (from the coordinate origin) of the stage **19** along Y axis direction, namely, a stage Y coordinate Ys (pseudo defect stage Y coordinate Ys**0**). AY scale error **62** is generated along Y axis direction. The larger the transportation amount (stage Y coordinate Ys (pseudo defect stage Y coordinate Ys**0**)) along Y axis direction of the stage **19** (from the coordinate origin), the larger the Y scale error **62**. Incidentally, there are cases where a Y scale error **62** is generated in a direction that increases a stage Y coordinate Ys (pseudo defect stage Y coordinate Ys**0**) (increases a transportation amount), and there are also cases where an Y scale error **62** is generated in an opposite direction that decreases a stage Y coordinate Ys.

(5) Orthogonal Degree Error

Using FIG. **13**, orthogonal degree errors **63**, which are errors along X axis direction generated on a transportation amount along Y axis direction of the stage **19**, will be described. A transportation amount along Y axis direction is a relative transportation amount between the line sensor **12***b* and the stage **19**. An orthogonal degree error **63** is generated on a transportation amount (from the coordinate origin) along Y axis direction of the stage **19**, namely, a stage Y coordinate Ys (pseudo defect stage Y coordinate Ys**0**). An orthogonal degree error **63** is generated along X axis direction. The larger the transportation amount (from the coordinate origin) along Y axis direction of the stage **19** (a stage Y coordinate Ys (pseudo defect stage Y coordinate Ys**0**)), the larger the orthogonal degree error **63**. Incidentally, there are not only cases that orthogonal degree errors **63** are generated in a direction from the left to the right along X axis direction, as shown in FIG. **13**, but also cases that orthogonal degree errors **63** are generated in an opposite direction from the right to the left.

In the following, coordinate error characteristic patterns will be described. In step S**6** in FIG. **2**, the characteristic pattern obtaining unit **33** (see FIGS. **1**A to **1**C) obtains plural, for example, three kinds of coordinate error characteristic patterns. The processing device **21** displays an obtained coordinate error characteristic pattern on the image display device **28**. Three kinds of examples of coordinate error characteristic patterns will be taken below.

(1) Shown is a pattern that represents the relationship of a difference ΔX to a pseudo defect stage X coordinate Xs**0**, and is a coordinate error characteristic pattern CP**1** related to inclination error **58** and X scale error **61**.

(2) Shown is a pattern that represents the relationship of a difference ΔY to a pseudo defect stage Y coordinate Ys**0**, and is a coordinate error characteristic pattern CP**2** related to magnification ratio error **59** and Y scale **62**.

(3) Shown is a pattern that represents the relationship of a difference ΔX to a pseudo defect stage Y coordinate Ys**0**,

and is a coordinate error characteristic pattern CP3 related to inclination error **58** and orthogonal degree error **63**.

(1) Coordinate Error Characteristic Pattern CP1

FIG. **14** and FIG. **15** show an example of coordinate error characteristic pattern CP1 representing the relationship of a difference ΔX to a pseudo defect stage X coordinate Xs0.

FIG. **14** shows an example of coordinate error characteristic pattern CP1 where neither an inclination error **58** nor an X scale error **61** is generated and difference ΔX does not exist (is zero). In case that neither an inclination error **58** nor an X scale error **61** is generated and difference ΔX does not exist (is zero), as shown in FIG. **14**, the coordinate error characteristic pattern CP1 is not dependent on the pseudo defect stage X coordinate Xs0, and becomes a line L1 showing that difference ΔX is zero and constant.

FIG. **15** shows an example of coordinate error characteristic pattern CP1 where inclination error **58** and X scale error **61** are generated and difference ΔX exists (is not zero). In case that inclination errors **58** and X scale errors **61** are generated and difference ΔX exists (is not zero), as shown in FIG. **15**, the coordinate error characteristic pattern CP1 is in a sawtooth waveform. The coordinate error characteristic pattern CP1 in this sawtooth waveform vibrates with an amplitude A1 of a sawtooth waveform corresponding to the height of the each sawtooth forming a sawtooth wave. The amplitude A1 is not dependent on the pseudo defect stage X coordinate Xs0 and is constant. Further, the coordinate error characteristic pattern CP1 in the sawtooth waveform tends to increase along the line L1 having an inclination AL1.

The coordinate error characteristic pattern CP1 in the sawtooth waveform is formed by plural sawteeth. The points (black rhombuses in FIG. **15**) forming the each sawtooth correspond to the respective channels C1-C9-C16 (**12***c*). In one sawtooth, the difference ΔX by the channel C1 is the smallest, and the difference ΔX by the channel C16 is the largest. Further, in one sawtooth, the pseudo defect stage X coordinate Xs0 by the channel C1 is the smallest, and the pseudo defect stage X coordinate Xs0 by the channel C16 is the largest. Thus, the points (black rhombuses in FIG. **15**) forming respective sawteeth are, as shown in FIG. **15**, disposed on a line having an inclination Atdix. The amplitude A1 and the inclination Atdix of the sawtooth wave have a correlationship that the larger the amplitude A1 of the sawtooth, the larger the inclination Atdix. It is understood from the above that amplitude A1 and inclination Atdix are caused by inclination error **58**. In contrast, it is understood that amplitude A1 and inclination Atdix are not generated by X scale error **61**.

On the other hand, the inclination AL1 of the line L1 is dependent on the pseudo defect stage X coordinate Xs0, wherein the larger the pseudo defect stage X coordinate Xs0, the larger the inclination AL1 of the line L1. Accordingly, it is understood that inclination AL1 is generated by X scale error **61**. It is also understood that inclination AL1 of line L1 is not generated by inclination error **58**.

From the above, inclination error **58** can be detected, based on the amplitude A1 and the inclination Atdix of the coordinate error characteristic pattern CP1, and X scale error **61** can be detected, based on the inclination AL1 of the line L1 of the coordinate error characteristic pattern CP1. According to the coordinate error characteristic pattern CP1, inclination error **58** and X scale error **61** can be detected separately.

Incidentally, FIG. **15** shows an example of a coordinate error characteristic pattern CP1 wherein the inclination AL1 and the inclination Atdix are positive, however, without being limited thereto, the both may be negative. That is, arrangement may be made such that in one sawtooth of a sawtooth waveform of the coordinate error characteristic pattern CP1, the difference ΔX by the channel C1 is the largest while the difference ΔX by the channel C16 is the smallest, and the pseudo defect stage X coordinate Xs0 by the channel C1 is the largest while the pseudo defect stage X coordinate Xs0 by the channel C16 is the smallest. Further, arrangement may be made such that the inclination AL1 of the line L1 is negative, wherein the larger the pseudo defect stage X coordinate Xs0, the smaller the inclination AL1 of the line L1. Further, either the inclination AL1 or the inclination Atdix may be zero. Incidentally, a case that both the inclination AL1 and the inclination Atdix are zero corresponds to the example of a coordinate error characteristic pattern CP1 shown in FIG. **14**.

(2) Coordinate Error Characteristic Pattern CP2

FIG. **16** and FIG. **17** show an example of the coordinate error characteristic pattern CP2 which represents the relationship of difference ΔY to pseudo defect stage Y coordinate Ys0.

FIG. **16** shows an example of coordinate error characteristic pattern CP2 where neither magnification ratio error **59** nor Y scale error **62** is generated and difference ΔY does not exist (is zero). If neither magnification ratio error **59** nor Y scale error **62** is generated and difference ΔY does not exist (is zero), as shown in FIG. **16**, the coordinate error characteristic pattern CP2 is not dependent on pseudo defect stage Y coordinate Ys0, and becomes a line L2 showing that the difference ΔY is zero and constant.

FIG. **17** shows an example of coordinate error characteristic pattern CP2 where magnification ratio error **59** and Y scale error **62** are generated and difference ΔY exists (is not zero). In case that magnification ratio error **59** and Y scale error **62** are generated and difference ΔY exists (is not zero), as shown in FIG. **17**, the coordinate error characteristic pattern CP2 is in a sawtooth waveform. The coordinate error characteristic pattern CP2 in this sawtooth waveform vibrates with an amplitude A2 of a sawtooth waveform corresponding to the height of the each sawtooth forming a sawtooth wave. The amplitude A2 is not dependent on pseudo defect stage Y coordinate Ys0 and is constant. Further, the coordinate error characteristic pattern CP2 in the sawtooth waveform tends to increase along the line L2 with an inclination AL2.

The coordinate error characteristic pattern CP2 in the sawtooth waveform is formed by plural sawteeth. The points (black rhombuses in FIG. **17**) forming respective sawtooth correspond to the respective channels C1-C9-C16 (**12***c*). In one sawtooth, the difference ΔY by the channel C1 is the smallest, and the difference ΔY by the channel C16 is the largest. Further, in one sawtooth, the pseudo defect stage Y coordinate Ys0 by the channel C1 is the smallest, and the pseudo defect stage Y coordinate Ys0 by the channel C16 is the largest. Thus, the points (black rhombuses in FIG. **17**) forming respective sawteeth are disposed on a line having an inclination Atdiy. The amplitude A2 and the inclination Atdiy of a sawtooth wave have a correlationship that the larger the amplitude A2 of the sawtooth, the larger the inclination Atdiy. It is understood from the above that the amplitude A2 and the inclination Atdiy are caused by a magnification ratio error **59**. In contrast, it is understood that neither amplitude A2 nor inclination Atdiy is generated by Y scale error **62**.

On the other hand, the inclination AL2 of the line L2 is dependent on pseudo defect stage Y coordinate Ys0, wherein the larger the pseudo defect stage Y coordinate Ys0, the larger the inclination AL2 of the line L2. Accordingly, it is understood that the inclination AL2 is generated by Y scale error **62**. It is also understood that the inclination AL2 of the line L2 is not generated by magnification ratio error **59**.

From the above, magnification ratio error **59** can be detected, based on the amplitude A2 and the inclination Atdiy

of the coordinate error characteristic pattern CP2, and Y scale error 62 can be detected, based on the inclination AL2 of the line L2 of the coordinate error characteristic pattern CP2. According to the coordinate error characteristic pattern CP2, magnification ratio error 59 and Y scale error 62 can be detected separately.

Incidentally, as an example of coordinate error characteristic pattern CP2, FIG. 17 shows such that the inclination AL2 and the inclination Atdiy are positive, however, without being limited thereto, both of these may be negative. That is, arrangement may be made such that in one sawtooth of a sawtooth waveform of the coordinate error characteristic pattern CP2, the difference ΔY by the channel C1 is the largest while the difference ΔY by the channel C16 is the smallest, and the pseudo defect stage Y coordinate Ys0 by the channel C1 is the largest while the pseudo defect stage Y coordinate Ys0 by the channel C16 is the smallest. Further, arrangement may be made such that the inclination AL2 of the line L2 is negative, wherein the larger the pseudo defect stage Y coordinate Ys0, the smaller the inclination AL2 of the line L2. Further, either the inclination AL2 or the inclination Atdiy may be zero. Incidentally, a case that both the inclination AL2 and the inclination Atdiy are zero corresponds to the example of a coordinate error characteristic pattern CP2 shown in FIG. 16.

(3) Coordinate Error Characteristic Pattern CP3

FIG. 18 and FIG. 19 show an example of the coordinate error characteristic pattern CP3 which represents the relationship of difference ΔX to pseudo defect stage Y coordinate Ys0.

FIG. 18 shows an example of coordinate error characteristic pattern CP3 where neither inclination error 58 nor orthogonal degree error 63 is generated and difference ΔX does not exist (is zero). In case that neither inclination error 58 nor orthogonal degree error 63 is generated and difference ΔX does not exist (is zero), as shown in FIG. 18, the coordinate error characteristic pattern CP3 is not dependent on pseudo defect stage Y coordinate Ys0, and becomes a line L3 which shows that the difference ΔX is zero and constant.

FIG. 19 shows an example of coordinate error characteristic pattern CP3 where inclination error 58 and orthogonal degree error 63 are generated and difference ΔX exists (is not zero). In case that inclination error 58 and orthogonal degree error 63 are generated and difference ΔX exists (is not zero), as shown in FIG. 19, the coordinate error characteristic pattern CP3 is in a sawtooth waveform. The coordinate error characteristic pattern CP3 in this sawtooth waveform vibrates with an amplitude A3 of a sawtooth waveform corresponding to the height of the each sawtooth forming a sawtooth wave. The amplitude A3 is not dependent on pseudo defect stage Y coordinate Ys0 and is constant. Further, the coordinate error characteristic pattern CP3 in the sawtooth waveform tends to increase along the line L3 with an inclination AL3.

The coordinate error characteristic pattern CP3 in the sawtooth waveform is formed by plural sawteeth. The points (black rhombuses in FIG. 19) forming respective sawteeth correspond to the respective channels C1-C9-C16 (12*c*). In one sawtooth, the difference ΔX by the channel C1 is the smallest, and the difference ΔX by the channel C16 is the largest. Further, in one sawtooth, the pseudo defect stage Y coordinate Ys0 by the channel C1 is the smallest, and the pseudo defect stage Y coordinate Ys0 by the channel C16 is the largest. Thus, the points (black rhombuses in FIG. 19) forming respective sawteeth are disposed on a line having an inclination Atdixy. The amplitude A3 and the inclination Atdixy of the sawtooth wave have a correlationship that the larger the amplitude A3 of the sawtooth, the larger the inclination Atdixy. It is understood from the above that the amplitude A3 and the inclination Atdixy are caused by inclination error 58. In contrast, it is understood that amplitude A3 and the inclination Atdixy are not generated by orthogonal degree error 63.

On the other hand, the inclination AL3 of the line L3 is dependent on pseudo defect stage Y coordinate Ys0, wherein the larger the pseudo defect stage Y coordinate Ys0, the larger the inclination AL3 of the line L3. Accordingly, it is understood that the inclination AL3 is generated by orthogonal degree error 63. It is also understood that the inclination AL3 of the line L3 is not generated by inclination error 58.

From the above, the inclination error 58 can be detected, based on the amplitude A3 and the inclination Atdixy of the coordinate error characteristic pattern CP3, and orthogonal degree error 63 can be detected, based on the inclination AL3 of the line L3 of the coordinate error characteristic pattern CP3. According to the coordinate error characteristic pattern CP3, inclination error 58 and the orthogonal degree error 63 can be detected separately.

Incidentally, as an example of coordinate error characteristic pattern CP3, FIG. 19 shows such that the inclination AL3 and the inclination Atdixy are positive, however, without being limited thereto, both of these may be negative. That is, arrangement may be made such that in one sawtooth of a sawtooth waveform of the coordinate error characteristic pattern CP3, the difference ΔX by the channel C1 is the largest while the difference ΔX by the channel C16 is the smallest, and the pseudo defect stage Y coordinate Ys0 by the channel C1 is the largest while the pseudo defect stage Y coordinate Ys0 by the channel C16 is the smallest. Further, arrangement may be made such that the inclination AL3 of the line L3 is negative, wherein the larger the pseudo defect stage Y coordinate Ys0, the smaller the inclination AL3 of the line L3. Further, either the inclination AL3 or the inclination Atdixy may be zero. Incidentally, a case that both the inclination AL3 and the inclination Atdixy are zero corresponds to the example of a coordinate error characteristic pattern CP3 shown in FIG. 18.

Returning to FIG. 2, in step S7, the processing device 21 displays the coordinate error characteristic patterns CP1, CP2, and CP3 to the operator, and prompts determination whether or not the coordinate error characteristic patterns CP1, CP2, and CP3 are appropriate via GUI. If coordinate error characteristic patterns CP1, CP2, and CP3, such as shown in FIGS. 14 to 19 are displayed, the operator determines appropriateness (step S7, Yes), and the process proceeds to step S8, and if a display is made otherwise (step S7, No), the operator determines inappropriateness, and the process proceeds to step S4.

In step S8, the inclination obtaining unit 34 determines the lines L1, L2, and L3 having the inclinations AL1, AL2, and AL3, based on the coordinate error characteristic patterns CP1, CP2, and CP3. Further, the amplitude obtaining unit 35 determines the lines having the inclinations Atdix, Atdiy, and Atdixy, based on the coordinate error characteristic patterns CP1, CP2, and CP3. The amplitude obtaining unit 35 determines the upper and the lower end of sawteeth used in computing the amplitudes A1, A2, and A3, based on the coordinate error characteristic patterns CP1, CP2, and CP3.

Further, in step S8, the stage correction factor computing unit 36 computes the inclinations AL1, AL2, and AL3 as stage correction factors, based on the determined lines L1, L2, and L3. The inclinations AL1, AL2, and AL3, which are stage correction factors, represent ratios of errors generated on the transportation of the stage 19.

Concretely, the inclination AL1, which is a stage correction factor, represents the ratio of generated X scale error **61** (difference ΔX) to stage X coordinate Xs of the stage **19**. Accordingly, by multiplying the stage X coordinate Xs by the inclination AL1, which is the stage correction factor, the X scale error **61** (difference ΔX) at the stage X coordinate Xs can be computed.

Concretely, the inclination AL2, which is a stage correction factor, represents the ratio of generated Y scale error **62** (difference ΔY) to stage Y coordinate Ys of the stage **19**. Accordingly, by multiplying the stage Y coordinate Ys by the inclination AL2, which is the stage correction factor, the Y scale error **62** (difference ΔY) at the stage Y coordinate Ys can be computed.

Concretely, the inclination AL3, which is a stage correction factor, represents the ratio of generated orthogonal degree error **63** (difference ΔX) to stage Y coordinate Ys of the stage **19**. Accordingly, by multiplying the stage Y coordinate Ys by the inclination AL3, which is the stage correction factor, the orthogonal degree error **63** (difference ΔX) at the stage Y coordinate Ys can be computed.

Further, in step S**8**, the channel correction factor computing unit **37** computes the amplitudes A1, A2, and A3, based on the determined upper and the lower end of sawteeth. Then, based on the amplitudes A1, A2, and A3, the channel correction factor computing unit **37** computes channel correction factors, which are the ratios of errors to the pitch Pc of the channels **12***c*, the errors being due to the channels **12***c*. Concretely, the channel correction factor computing unit **37** computes the inclinations Atdix, Atdiy, and Atdixy as channel correction factors, based on the lines having the determined inclinations Atdix, Atdiy, and Atdixy.

The inclination Atdix, which is a channel correction factor, represents the ratio of inclination error **58** (difference ΔX) to the pitch Pc of channels **12***c* (the pitch Pd of pseudo defects **54**), the inclination error **58** being due to the channel **12***c*. As an inclination error **58** is generated for each pseudo defect die **52**, the inclination error **58** (difference ΔX) at a die X coordinate Xd can be computed by multiplying the die X coordinate Xd by the inclination Atdix, which is the channel correction factor.

The inclination Atdiy, which is a channel correction factor, represents the ratio of the magnification ratio error **59** (difference ΔY) to the pitch Pc of channels **12***c* (the pitch Pd of pseudo defects **54**), the inclination error **58** being due to the channel **12***c*. As a magnification ratio error **59** is generated for each pseudo defect die **52**, the magnification ratio error **59** (difference ΔY) at a die Y coordinate Yd can be computed by multiplying the die Y coordinate Yd by the inclination Atdiy, which is the channel correction factor.

The inclination Atdixy, which is a channel correction factor, represents the ratio of the inclination error **58** (difference ΔX) to the pitch Pc of channels **12***c* (the pitch Pd of pseudo defects **54**), the inclination error **58** being due to the channel **12***c*. As an inclination error **58** is generated for each pseudo defect die **52**, the inclination error **58** (difference ΔX) at a die Y coordinate Yd can be computed by multiplying the die Y coordinate Yd by the inclination Atdixy, which is the channel correction factor.

In step S**9** in FIG. **2**, the storing/transmitting unit **41** stores the inclinations AL1, AL2, AL3, which are stage correction factors, and the inclinations Atdix, Atdiy, and Atdixy, which are channel correction factors.

Then, in step S**10**, the optical type inspection apparatus **1** again performs inspection of the entire surface of the wafer for coordinates management **51**, using the scan table created in step S**2**. However, differently from the inspection of the entire surface in step S**4**, in the inspection of the entire surface of this time in step S**10**, the correction factors, which have become zero by initialization, are changed to the inclination AL1, AL2, or AL3, which are stage correction factors, and the inclination Atdix, Atdiy, or Atdixy, which are channel correction factors.

Then, first, similarly to step S**4**, all the pseudo defects **54** in the wafer for coordinates management **51** and the pseudo defect dies **52** are detected, and pseudo defect stage coordinates (pseudo X coordinate Xs**0**, pseudo defect stage Y coordinate Ys**0**), which are at the positions where these have been detected, are detected by the stage position detecting units (Y scale, X scale, and coordinate management device) **13**, **14**, and **25** (see FIGS. **1**A to **1**C). The coordinate transforming unit **31** (see FIGS. **1**A to **1**C) transforms the detected pseudo defect stage coordinates (pseudo defect stage X coordinate Xs**0**, pseudo defect stage Y coordinate Ys**0**) into pseudo defect die coordinates (pseudo defect die X coordinate Xd**0**, pseudo defect die Y coordinate Yd**0**), which represent the potions in the pseudo defect dies **52** including the corresponding pseudo defects **54**. The storing/transmitting unit **41** (see FIGS. **1**A to **1**C) stores the pseudo defect stage coordinates (pseudo defect stage X coordinate Xs**0**, pseudo defect stage Y coordinate Ys**0**) and the pseudo defect die coordinates (pseudo defect die X coordinate Xd**0**, pseudo defect die Y coordinate Yd**0**).

That is, in step S**10**, differently from step S**4**, further, the pseudo defect die coordinates (pseudo defect die X coordinate Xd**0**, pseudo defect die Y coordinate Yd**0**) are corrected for high accuracy. Concretely, the stage correction amount computing unit **38** multiply the pseudo defect coordinates (pseudo defect stage X coordinate Xs**0**, pseudo defect stage Y coordinate Ys**0**) having been detected in this step S**10** by a stage correction factor, and thereby computes stage correction amounts.

More concretely, as represented by Expression (1), by multiplying a pseudo defect stage X coordinate Xs**0** by an inclination AL**1** which is a stage correction factor, the X scale error **61** (difference ΔX) at the pseudo defect stage X coordinate Xs**0**, namely, the stage correction amount ΔXds (No. 1) can be computed.

$$\Delta Xds(X \text{ scale error } 61)=Xs0\times AL1 \tag{1}$$

Likewise, as represented by Expression (2), by multiplying a pseudo defect stage Y coordinate Ys**0** by an inclination AL**2**, which is a stage correction factor, the Y scale error **62** (difference ΔY) at the pseudo defect stage Y coordinate Ys**0**, namely, the stage correction amount ΔYds can be computed.

$$\Delta Yds(Y \text{ scale error } 62)=Ys0\times AL2 \tag{2}$$

As represented by Expression (3), by multiplying a pseudo defect stage Y coordinate Ys**0** by an inclination AL**3**, which is a stage correction factor, the orthogonal degree error **63** (difference ΔX) at the pseudo defect stage Y coordinate Ys**0**, namely, the stage correction amount ΔXds (No. 2) can be computed.

$$\Delta Xds(\text{orthogonal degree error } 63)=Ys0\times AL3 \tag{3}$$

The computation of these stage correction amounts means performing back calculation of computation of the stage correction factors in step S**8**, and means performing so-called proof calculation. The correctness of this proof calculation is verified in steps S**10** to S**13**.

Concretely, the die correction amount computing unit **39** computes die correction amounts by multiplying the pseudo defect die coordinates (pseudo defect die X coordinate Xd**0**, pseudo defect die Y coordinate Yd**0**) by channel correction factors.

More concretely, as represented by Expression (4), by multiplying a pseudo defect die X coordinate Xd**0** by an inclination Atdix, which is a channel correction factor, the inclination error **58** (difference ΔX) at the pseudo defect die X coordinate Xd**0**, namely, the die correction amount ΔXdd (No. 1) can be computed.

$$\Delta Xdd(\text{inclination error } 58) = Xd0 \times Atdix \tag{4}$$

Likewise, as represented by Expression (5), by multiplying a pseudo defect die Y coordinate Yd**0** by an inclination Atdiy, which is a channel correction factor, the magnification ratio error **59** (difference ΔY) at the pseudo defect die Y coordinate Yd**0**, namely, the die correction amount ΔYdd can be computed.

$$\Delta Ydd(\text{magnification ratio error } 59) = Yd0 \times Atdiy \tag{5}$$

As represented by Expression (6), by multiplying a pseudo defect die Y coordinate Yd**0** by an inclination Atdixy, which is a channel correction factor, the inclination error **58** (difference ΔX) at the pseudo defect die Y coordinate Yd**0**, namely, the die correction amount ΔXdd (No. 2) can be computed. Incidentally, both a die correction amount ΔXdd (No. 1) and a correction amount ΔXdd (No. 2) correspond to an inclination error **58**, wherein it is only necessary to compute either one.

$$\Delta Xdd(\text{inclination error } 58) = Yd0 \times Atdixy \tag{6}$$

The computation of these die correction amounts means performing back calculation of computation of the channel correction factors in step S**8**, and means performing so-called proof calculation. The correctness of this proof calculation is verified in steps S**10** to S**13**.

A pseudo defect stage coordinate (pseudo defect stage X coordinate Xs**0**, pseudo defect stage Y coordinate Ys**0**) and a pseudo defect die coordinate (pseudo defect die X coordinate Xd**0**, pseudo defect die Y coordinate Yd**0**) are different in coordinate system, however, the both represent the same one point (the position of the same pseudo defect **54**) on the wafer for coordinates management **51** (pseudo defect die **52**). The correction amount at this one point can be computed as the sum of the stage correction amount and the die correction amount.

That is, as represented by Expression (7), the die coordinate correcting unit **40** adds a stage correction amount ΔXds (X scale error **61**), a stage correction amount ΔXds (orthogonal degree error **63**), and a die correction amount ΔXdd (inclination error **58**) to a pseudo defect die X coordinate Xd**0** (or a pseudo defect stage X coordinate Xs**0**), and thereby computes a corrected pseudo defect die X coordinate Xdm**0** (or a corrected pseudo defect stage X coordinate Xsm**0**).

$$Xdm0(Xsm0) = Xd0(Xs0) + \Delta Xds(X \text{ scale error } 61) + \Delta Xds(\text{orthogonal degree error } 63) + \Delta Xdd(\text{inclination error } 58) \tag{7}$$

Further, as represented by Expression (8), the die coordinate correcting unit **40** adds a stage correction amount ΔYds (Y scale error **62**) and a die correction amount ΔYdd (magnification ratio error **59**) to a pseudo defect die Y coordinate Yd**0** (or a pseudo defect stage Y coordinate Ys**0**), and thereby computes a corrected pseudo defect die Y coordinate Ydm**0** (or a corrected pseudo defect stage Y coordinate Ysm**0**).

$$Ydm0(Ysm0) = Yd0(Ys0) + \Delta Yds(Y \text{ scale error } 62) + \Delta Ydd(\text{magnification ratio error } 59) \tag{8}$$

The storing/transmitting unit **41** (see FIGS. **1**A to **1**C) stores corrected pseudo defect die X coordinates Xdm**0** (or corrected pseudo defect stage X coordinates Xsm**0**) and corrected pseudo defect die Y coordinates Ydm**0** (or corrected pseudo defect stage Y coordinates Ysm**0**). Now, step S**10** is completed. Incidentally, although inspection of the entire surface of the wafer for coordinates management **51** is performed also in step S**4**, as the correction factors (the stage correction factors AL**1**, AL**2**, and AL**3**, and the channel correction factors Atdix, Atdiy, and Atdixy) are set to zero (AL**1** AL**2**, AL**3**, Atdix, Atdiy, Atdixy =0), the stage correction amounts ΔXds (X scale errors **61**) are zero (ΔXds (X scale errors **61**) =0), according to Expression (1); the stage correction amounts ΔYds (Y scale error **62**) are zero (ΔYds (Y scale errors **62**) =0), according to Expression (2); the stage correction amounts ΔXds (orthogonal degree error **63**)are zero (ΔXds (orthogonal degree errors **63**) =0), according to Expression (3); the die correction amounts ΔXdd (inclination error **58**) are zero (ΔXdd (inclination errors **58**) =0), according to Expression (4); the die correction amounts ΔYdd (magnification ratio errors **59**) are zero (die correction amounts ΔYdd (magnification ratio error **59**) =0),according to Expression (5); and the die correction amounts ΔXdd (inclination errors **58**) are zero (ΔXdd (inclination errors **58**) =0), according to Expression (6). By these, in Expression (7), the corrected pseudo defect die X coordinates Xdm**0** (or the corrected pseudo defect stage X coordinates Xsm**0**) become equal to the pseudo defect die X coordinates Xd**0** (or the pseudo defect stage X coordinates Xs**0**), in other words (Xdm0(Xsm0) =Xd0(Xs0); and in Expression (8), the corrected pseudo defect die Y coordinates Ydm**0** (or the corrected pseudo defect stage Y coordinates Ysm**0**) become equal to the pseudo defect die Y coordinates Yd**0** (or the pseudo defect stage Y coordinates Ys**0**), in other words, Ydm0 (Ysm0) =Yd0(Ys0). In such a manner, the pseudo defect die X coordinates Xd**0** (or the pseudo defect stage X coordinates Xs**0**) and the pseudo defect die Y coordinates Yd**0** (or the pseudo defect stage Y coordinates Ys**0**) are virtually obtained.

Then, in step S**11** similarly to the process in step S**5**, the difference computing unit **32** computes differences ΔX (=Xdm**0**−Xd**2**), ΔY (=Ydm**0**−Yd**2**) of the corrected pseudo defect die coordinates (corrected pseudo defect die X coordinate Xdm**0**, corrected pseudo defect die Y coordinate Ydm**0**) from designed coordinates (designed X coordinate Xd**2**, designed Y coordinate Yd**2**) which are based on design, wherein the differences ΔX and AY are generated when the pseudo defects **54** are formed in the pseudo defect dies **52**.

Then, in step S**12** similarly to the process in step S**6**, the characteristic pattern obtaining unit **33** obtains coordinate error characteristic patterns CP**1**, CP**2**, and CP**3**, using the computed differences ΔX and ΔY computed in step S**11**, and displays them on the image display device **28**. Further, for comparison, the characteristic pattern obtaining unit **33** also displays the coordinate error characteristic patterns CP**1**, CP**2**, and CP**3** obtained in step S**6** on the image display device **28**.

In step S**13**, the processing device **21** displays for the operator the coordinate error characteristic patterns CP**1**,

CP2, and CP3 having been obtained in step S12 and step S6 via GUI, and prompts the operator to determine whether or not errors are eliminated by correction (whether correction is appropriate) from the characteristic patterns CP1, CP2, and CP3 obtained in step S12. If errors, as shown in FIG. 14, FIG. 16, and FIG. 18, are eliminated and coordinate error characteristic patterns CP1, CP2, and CP3 are displayed as if errors were not generated, the operator determines that the correction is appropriate (step S13, Yes) and the process proceeds to step S14. On the other, if display is made not in such a manner, the operator determines that the correction is not appropriate (step S13, No), and the process returns to step S4. Incidentally, if the correction is appropriate, the differences ΔX and ΔY computed in step S11 result in zero. Herein, determination whether or not the correction is appropriate may be determined, dependent on whether or not the differences ΔX and AY computed in step S11 are within a predetermined value near zero, as shown in step S13 in FIG. 2.

If the step proceeds to step S14, it is understood that accurate correction of the defect coordinates can be made with the obtained correction factors. Steps S14 and after will be described on a case of inspecting a mass production wafer.

In step S14, the optical type inspection apparatus 1 performs inspection of the entire surface of a mass production wafer 71, using a scan table for a mass production wafer 71, the scan table having been prepared in advance. Similarly to the entire surface inspection in step S10, in the entire surface inspection of this time in step S14, correction factors are set to the inclinations AL1, AL2, and AL3, which are the stage correction factors computed in step S8, and the inclinations Atdix, Atdiy, and Atdixy, which are the channel correction factors computed in step S8.

FIG. 20 shows a plan view of the mass production wafer 71 under manufacturing. A matrix is set on the surface of the mass production wafer 71. Plural rows l1, l2, . . . , lm, . . . and plural columns r1, r2, . . . rn, . . . are set in the matrix. Mass production dies 72 are formed on all the columns r1, r2, rn, . . . across the respective rows l1, l2, . . . , lm, ...

FIG. 21 shows the mass production wafer 71, which is fixed on the stage 19. The mass production wafer 71 is provided with mass production dies 72. As shown in FIG. 21, for example, it will be assumed that a real defect 74 is generated in the mass production die 72 at the row/column (lm1, rn1). As described later, the real defect 74 is determined to be a defect by the defect determination device 24 in FIGS. 1A to 1C, and a real defect stage coordinate (a real defect stage Y coordinate Ys1 and a real defect stage X coordinate Xs1) is stored in the inspection result storage device 26, as the position where the real defect 74 is located on stage coordinate (a stage Y coordinate Ys and a stage X coordinate Xs).

FIG. 22 shows a plan view of mass production dies 72. Die cells 73 are formed in the mass production dies 72. In the example in FIG. 22, totally four die cells 73 are formed on vertically and horizontally 2 rows. It is assumed that a real defect 74 is generated in one die cell 73 out of the four die cells 73. The real defect 74 shown in FIG. 22 is the same as the real defect 74 shown in FIG. 21 and is generated at the same position, however, the coordinate systems representing the position are different between FIG. 21 and FIG. 22. In FIG. 21, the position of the real defect 74 is expressed as a real defect stage coordinate (real defect stage Y coordinate Ys1 and real defect stage X coordinate Xs1), by the use of stage coordinate (stage Y coordinate Ys and stage X coordinate Xs). On the other hand, in FIG. 22, the position of the real defect 74 is expressed as a real defect die coordinate (real defect die Y coordinate Yd1 and real defect die X coordinate Xd1), by the use of die coordinate (die Y coordinate Yd and die X coordinate Xd). The real defect stage coordinate (real defect stage Y coordinate Ys1 and real defect stage X coordinate Xs1) can be transferred with one to one relationship into real defect die coordinate (real defect die Y coordinate Yd1 and real defect die X coordinate Xd1).

In the entire surface inspection of the mass production wafer 71, if correction factors (stage correction factors AL1, AL2, AL3, channel correction factors Atdix, Atdiy, Atdixy), which are not zero, are set in advance, it is considered that a real defect stage coordinate (real defect stage Y coordinate Ys1 and real defect stage X coordinate Xs1) or a real defect die coordinate (real defect die Y coordinate Yd1 and real defect die X coordinate Xd1) includes errors 58-63, and correction is accordingly performed. In the correction, a correction amount ΔXd (ΔXds, ΔXdd) is added to the real defect die X coordinate Xd1 to compute a corrected real defect die X coordinate Xdm, and a correction amount AYd (ΔYds, ΔYdd) is added to the real defect die Y coordinate Yd1 to compute a corrected real defect die Y coordinate Ydm. Thus, a highly accurate defect coordinate (corrected real defect die X coordinate Xdm, corrected real defect die Y coordinate Ydm) can be obtained.

That is, in step S14, the following is performed. All real defects 74 in the mass production wafer 71 and the mass production dies 72 are detected, and real defect stage coordinates (real defect stage X coordinate Xs1, real defect stage Y coordinate Ys1), which are the positions where the real defects 74 have been detected, are detected by the stage position detecting units (Y scale, X scale, coordinate management device) 13, 14, and 25 (see FIGS. 1A to 1C). The coordinate transforming unit 31 (see FIGS. 1A to 1C) transforms the detected real defect stage coordinates (real defect stage X coordinate Xs1, real defect stage Y coordinate Ys1) into real defect die coordinates (real defect die X coordinate Xd1, real defect die Y coordinate Yd1) representing the positions in the mass production dies 72 where the corresponding real defects 74 are included. The storing/transmitting unit 41 (see FIGS. 1A to 1C) stores the real defect stage coordinates (real defect stage X coordinate Xs1, real defect stage Y coordinate Ys1) and the real defect die coordinates (real defect die X coordinate Xd1, real defect die Y coordinate Yd1).

Further, in step S14 in FIG. 2, the stage correction amount computing unit 38 multiplies the real defect stage coordinates (real defect stage X coordinate Xs1, real defect stage Y coordinate Ys1), which have been detected in this step S14, by stage correction factors, and thereby computes stage correction amounts.

Concretely, as expressed by Expression (11), the stage correction amount computing unit 38 multiplies a real defect stage X coordinate Xs1 by the inclination AL1, which is a stage correction factor, and thereby computes an X scale error 61 (difference ΔX), namely a stage correction amount ΔXds (No. 1), at the real defect stage X coordinate Xs1.

$$\Delta Xds(X \text{ scale error } 61) = Xs1 \times AL1 \tag{11}$$

Likewise, as expressed by Expression (12), the stage correction amount computing unit 38 multiplies a real defect stage Y coordinate Ys1 by the inclination AL2, which is a stage correction factor, and thereby computes a Y scale error 62 (difference ΔY), namely a stage correction amount ΔYds, at the real defect stage Y coordinate Ys1.

$$\Delta Yds(Y \text{ scale error } 62) = Ys1 \times AL2 \tag{12}$$

As expressed by Expression (13), the stage correction amount computing unit 38 multiplies the real defect stage Y coordinate Ys1 by the inclination AL3, which is a stage correction factor, and thereby computes an orthogonal degree

error **63** (difference ΔX), namely a stage correction amount ΔXds (No, 2), at the real defect stage Y coordinate Ys**1**.

$$\Delta Xds(\text{orthogonal degree error } 63) = Ys1 \times AL3 \quad (13)$$

Further, in step S**14** in FIG. **2**, the die correction amount computing unit **39** computes a die correction amount by multiplying the real defect die coordinate (real defect die X coordinate Xd**1**, real defect die Y coordinate Yd**1**) by a channel correction factor.

Concretely, as represented by Expression (14), by multiplying the real defect die X coordinate Xd**1** by the inclination Atdix, which is a channel correction factor, the die correction amount computing unit **39** computes the inclination error **58** (difference ΔX), namely the die correction amount ΔXdd (No. 1), at the real defect die X coordinate Xd**1**.

$$\Delta Xdd(\text{inclination error } 58) = Xd1 \times Atdix \quad (14)$$

Likewise, as represented by Expression (15), by multiplying the real defect die Y coordinate Yd**1** by the inclination Atdiy, which is a channel correction factor, the die correction amount computing unit **39** computes a magnification ratio error **59** (difference ΔY), namely the die correction amount ΔYdd, at the real defect die Y coordinate Yd**1**.

$$\Delta Ydd(\text{magnification ratio error } 59) = Yd1 \times Atdiy \quad (15)$$

As represented by Expression (16), by multiplying the real defect die Y coordinate Yd**1** by the inclination Atdixy, which is a channel correction factor, the die correction amount computing unit **39** computes an inclination error **58** (difference ΔX), namely the die correction amount ΔXdd (No. 2), at the real defect die Y coordinate Yd**1**. Incidentally, both the die correction amount ΔXdd (No. 1) and the die correction amount ΔXdd (No. 2) correspond to the inclination error **58**, wherein it is only necessary to compute either one.

$$\Delta Xdd(\text{inclination error } 58) = Yd1 \times Atdixy \quad (16)$$

A real defect stage coordinate (real defect stage X coordinate Xs**1**, real defect stage Y coordinate Ys**1**) and a real defect die coordinate (real defect die X coordinate Xd**1**, real defect die Y coordinate Yd**1**) are different in the coordinate system, however, the both represent the same one point (the position of the same real defect **74**) on the mass production wafer **71** (mass production die **72**). The correction amount at this one point can be computed as the sum of the stage correction amount and the die correction amount.

That is, as represented by Expression (17), the die coordinate correcting unit **40** adds a stage correction amount ΔXds (X scale error **61**), a stage correction amount ΔXds (orthogonal degree error **63**), and a die correction amount ΔXdd (inclination error **58**) to the real defect die X coordinate Xd**1** (or the real defect stage X coordinate Xs**1**), and thereby computes a corrected real defect die X coordinate Xdm (or a corrected real defect stage X coordinate Xsm) (corrected defect coordinate).

$$Xdm(Xsm) = Xd1(Xs1) + \Delta Xds(X \text{ scale error } 61) + \Delta Xds(\text{orthogonal degree error } 63) + \Delta Xdd(\text{inclination error } 58) \quad (17)$$

Further, as represented by Expression (18), the die coordinate correcting unit **40** adds a stage correction amount ΔYds (Y scale error **62**) and a die correction amount ΔYdd (magnification ratio error **59**) to the real defect die Y coordinate Yd**1** (or the real defect stage Y coordinate Ys**1**), and thereby computes a corrected real defect die Y coordinate Ydm (or a corrected real defect stage Y coordinate Ysm) (corrected defect coordinate).

$$Ydm(Ysm) = Yd1(Ys1) + \Delta Yds(Y \text{ scale error } 62) + \Delta Ydd(\text{magnification ratio error } 59) \quad (18)$$

The storing/transmitting unit **41** stores corrected real defect die X coordinates Xdm (or corrected real defect stage X coordinates Xsm) and corrected real defect die Y coordinates Ydm (or corrected real defect stage Y coordinates Ysm). Now, step S**14** is completed.

In step S**15** in FIG. **2**, the storing/transmitting unit **41** transmits, to the review device, the corrected real defect die X coordinates Xdm (or the corrected real defect stage X coordinates Xsm) and the corrected real defect die Y coordinates Ydm (or the corrected real defect stage Y coordinates Ysm), which are corrected defect coordinates. As the review device can obtain corrected defect coordinates with high accuracy, it is possible to surely display a real defect **74**, even displaying the peripheral region of the correction defect coordinates with high magnification ratio. Now, the flow of the method of correcting defect coordinate, shown in FIG. **2**, can be completed.

FIG. **23** shows a configuration diagram of an inspection system **80** in the present embodiment according to the present invention. The inspection system **80** is provided with the optical type inspection apparatus **1** in the present embodiment according to the present invention. Further, the inspection system **80** includes a process control section **81**, a review device **82**, and a transportation system **83**.

The optical type inspection apparatus **1** and the review device **82** store recipes used in performing entire surface inspection of a wafer for coordinates management **51** or a mass production wafer **71**, displaying defects with magnification, or the like. These recipes may include a scan table. Each recipe is associated with a recipe identifier, and a recipe to be used for entire surface inspection can be read out, based on a recipe identifier received from the process control section **81**.

The process control section **81** transmits, to the optical type inspection apparatus **1** and the review device **82**, a recipe identifier corresponding to a wafer, such as a wafer for coordinates management **51** or a mass production wafer **71** to be loaded. Thus, the process control section **81** can manage the manufacturing process of mass production wafers **71** and manage the accuracy of defect coordinate on the optical type inspection apparatus **1**.

The review device **82** receives corrected defect coordinates (Xdm, Ydm) obtained by the optical type inspection apparatus **1**, directly or via the process control section **81**. The review device **82** displays, with magnification, the periphery of a position represented by a corrected defect coordinate (Xdm, Ydm) on the mass production wafer **71**, and can thereby display, with magnification, a real defect **74** at the corrected defect coordinate (Xdm, Ydm). The manufacturer of mass production wafers **71** used for a semiconductor device or a display device observes real defects **74** displayed with magnification, and can thereby find the generation cause of real defects **74** or reduce real defects **74**.

The transportation system **83** includes a stocker **83***a* capable of reserving a wafer for coordinates management **51** or a mass production wafer **71**. The transportation system **83** is connected with the optical type inspection apparatus **1** and the review device **82**, so as to load and unload a wafer for coordinates management **51** or a mass production wafer **71**. Further, the transportation system **83** is also connected with a

manufacturing device for processing mass production wafers **71**, so as to load and unload a mass production wafer **71**.

When a mass production wafer **71**, for which a process by the manufacturing device has once completed, is ready to be processed by the optical type inspection apparatus **1**, the transportation system **83** once reserves the mass production wafer **71** by the stocker **83***a*, and transmits an inspection waiting signal to the optical type inspection apparatus **1** to notify the optical type inspection apparatus **1** of the fact that there is wafer waiting for a process (inspection). After receiving the inspection waiting signal, when the optical type inspection apparatus **1** has become ready to perform entire surface inspection, the optical type inspection apparatus **1** transmits a load requesting signal to the transportation system **83** to request for loading the mass production wafer **71**. After receiving the load requesting signal, the transportation system **83** loads the mass production wafer **71** onto the optical type inspection apparatus **1**. Based on a recipe identifier obtained from the process control section **81**, the optical type inspection apparatus **1** reads out a recipe (scan table), and based on the recipe, performs entire surface inspection of the mass production wafer **71**. Thus, (data of) corrected defect coordinates are created. After completing the entire surface inspection, the optical type inspection apparatus **1** transmits an unload requesting signal to the transportation system **83** to request for unloading the mass production wafer **71**. Further, the optical type inspection apparatus **1** transmits (the data of) the corrected defect coordinates to the process control section **81**. The process control section **81** once stores (the data of) the corrected defect coordinates. After receiving the unload requesting signal, the transportation system **83** unloads the mass production wafer **71** from the optical type inspection apparatus **1**, then once reserves the mass production wafer **71** by the stocker **83***a*, and transmits a waiting signal to the review device **82** to notify the fact that there is a wafer waiting for processing.

After receiving the waiting signal, when the review device **82** has become ready to perform displaying of real defects **74** with magnification, the review device **82** transmits a load requesting signal to the transportation system **83** to request for loading the mass production wafer **71**. After receiving the load requesting signal, the transportation system **83** loads the mass production wafer **71** onto the review device **82**. The review device **82** receives a recipe identifier and the corrected defect coordinates from the process control section **81**. Based on the recipe identifier, the review device **82** reads out a recipe (scan table), and based on the recipe, displays with magnification a real defect **74** at a corrected defect coordinates on the mass production wafer **71**. After completing the process of displaying with magnification the real defects **74**, the review device **82** transmits an unload requesting signal to the transportation system **83** to request for unloading the mass production wafer **71**. After receiving the unload requesting signal, the transportation system **83** unloads the mass production wafer **71** from the review device **82**, then once reserves the mass production wafer **71** by the stocker **83***a*, and transmits a waiting signal to the manufacturing device to notify the fact that there is a wafer waiting for processing.

FIG. **24** shows a configuration diagram of the review device **82**. An electron scanning microscope is applied to the review device **82**. The vacuum container of an electron optical column **110** is not shown. An electron beam **117** generated by an electron gun **111** is projected through a condenser lens **112**, a deflector **113**, and an objective lens **114** to a mass production wafer (specimen) **115**. The electron beam **117** is narrowed by the condenser lens **112** and the objective lens **114**, and deflected by the deflector **113** so as to scan the surface of the mass production wafer **115** in order to obtain images with certain dimensions wherein a corrected defect coordinate is disposed at the center of an image. The excitation intensity of the condenser lens **112** is controlled by a condenser lens control unit **120**. The deflection amount by the deflector **113** is controlled by a deflector control unit **121** so as to obtain the images with the certain dimensions wherein a corrected defect coordinate is disposed at the center of an image. The excitation intensity of the objective lens **114** is controlled by an objective lens control unit **122**. The control amounts of the above-described controls are computed by a processor **129** of a computer **128** and transmitted from a control unit **126** to respective control units.

When the electron beam **117** is projected to the mass production wafer **115**, secondary signals, such as secondary electrons and reflected electrons having information of the shape and the material of the mass production wafer **115** (real defect **74**), are generated. Secondary signals generally include secondary electrons **118** with an energy lower than 50 eV and reflected electrons **119** with a higher energy. The secondary electrons **118** are detected by a lifting force and an upper detector **132**, not shown, and reflected electrons **119** are detected by plural detectors **133**. By a detector control unit **123**, detected secondary signals **118**, **119** are amplified, converted from an analog signal into a digital signal, and stored in an image memory **125** as image data. The plural detectors **133** are installed in such a manner, for example, that two detectors **133** face each other in order to obtain three dimensional information. The two detectors **133** are controlled by the detector control unit **123**. For a real defect **74** of the mass production wafer **115**, the detector control unit **123** generates an L image from a reflected electron (signal) **119** on the left side, and an R image from a reflected electron (signal) **119** on the right side. On the other hand, the detector control unit **123** generates an S image of a secondary electron image from a secondary electron **118** detected by the detector **132**.

An address control unit **124** generates an address, which is synchronized with a scan signal of an electron beam **117**, from deflection control data transmitted from the deflector control unit **121** such that a corrected defect coordinate is disposed at the center of an image, and the address is stored in the image memory **125**, being associated with an image signal from the detector control unit **123**. The image memory **125** transmits the stored image data (L image, R image, S image) to the computer **128**. From the image data, the computer **128** performs computation of a later-described evaluation value for focusing, fitting of the evaluation value by a function, and computation of the peak of the fitting function, generates a focus adjusting signal, and transmits the focus adjusting signal to the objective lens control unit **122**. The objective lens control unit **122** controls the excitation intensity of the objective lens **114** to adjust the focal point. For adjusting the focal point, there is a method of adjusting a focal point, using an input tool **130** or a dedicated input tool **131**, while the operator is viewing an image displayed on a display **127**, and there is also a method of automatic focusing that automatically adjust a focal point, based on the evaluation value of an obtained image, while the objective lens control unit **122** is changing the focal point of the objective lens **114**. The input tool **130** is an ordinary keyboard or a mouse, and the dedicated input tool **131** is a dedicated input tool provided with a joystick or a trackball for adjusting the electron scanning microscope. As another method of adjusting a focal point, as described in Japanese Patent Application Laid-Open No. 2007-242605, the position of a focal point may be changed by providing an electrostatic electrode, not shown, in the magnetic path of the objective lens **114** and changing an applied

voltage to this electrostatic electrode. The mass production wafer **115** is fixed by a specimen table **116**, such as an electrostatic chuck, and can be transported on a two dimensional plane in X axis direction and Y axis direction by a transporting stage **134** moved by a control signal from the control unit **126**. A function to transport, as necessary, the mass production wafer **115** along Z axis direction, which is the height direction, may be provided.

FIG. **25** is a flowchart of an operation method (a method of correcting defect coordinates) of the inspection system **80**.

First, in step S**21**, the processing device **21** of the optical type inspection apparatus **1** determines whether or not an instruction to set (reset) correction factors has been input to the processing device **21** by the operator. If an instruction to set (reset) correction factors has been input (step S**21**, Yes), the process proceeds to step S**22**, and if an instruction to set (reset) correction factors has not been input (step S**21**, No), the process proceeds to step S**27**.

Then, in step S**22**, the processing device **21** of the optical type inspection apparatus **1** transmits a request to the transportation system **83** to load a wafer for coordinates management **51**.

In step S**23**, the transportation system **83** loads a wafer for coordinates management **51** reserved in the stocker **83***a* onto the optical type inspection apparatus **1**.

In step S**24**, the processing device **21** of the optical type inspection apparatus **1** determines correction factors (AL**1**, AL**2**, and AL**3**, which are stage correction factors, and inclinations Atdix, Atdiy, and Atdixy, which are channel correction factors). Concretely, steps S**1** to S**13** in FIG. **2** are executed. Incidentally, once steps S**1** to S**3** in FIG. **2** are executed at the first time, steps S**1** to S**3** can be omitted from the second time as a wafer for coordinates management **51** and a scan table prepared at the first time can be used. Accordingly, steps S**4** to S**13** are executed from the second time.

In step S**25**, the processing device **21** of the optical type inspection apparatus **1** transmits a request to the transportation system **83** to unload the wafer for coordinates management **51**. The transportation system **83** unloads the wafer for coordinates management **51** from the optical type inspection apparatus **1** onto the stocker **83***a*.

In step S**26**, the processing device **21** of the optical type inspection apparatus **1** resets the timer **42** (see FIGS. **1**A to **1**C) that counts the correction period, and restarts the timer **42**.

In step S**27**, the processing device **21** of the optical type inspection apparatus **1** determines whether or not an instruction to stop the process has been input to the processing device **21** by the operator. If a strop instruction has been input (step S**27**, Yes), the processing device **21** stops the flow of the operation method (method of correcting defect coordinates) of the inspection system **80**, and if a stop instruction has not been input (step S**27**, No), the process proceeds to step S**28**.

In step S**28**, the processing device **21** of the optical type inspection apparatus **1** determines whether or not an inspection waiting signal has been received from the transportation system **83**, wherein the inspection waiting signal notifies that there is a mass production wafer **71** waiting for processing (inspection). If an inspection waiting signal has been received (step S**28**, Yes), the process proceeds to step S**29**, and if an inspection waiting signal has not been received (step S**28**, No), the process proceeds to step S**32**.

In step S**29**, the processing device **21** of the optical type inspection apparatus **1** transmits a load request to the transportation system **83** to load the mass production wafer **71** waiting for processing (inspection).

In step S**30**, the transportation system **83** loads the mass production wafer **71** waiting for processing (inspection) onto the optical type inspection apparatus **1**. Further, the process control section **81** loads an identifier of an inspection recipe to the processing device **21** of the optical type inspection apparatus **1**.

In step S**31**, the processing device **21** of the optical type inspection apparatus **1** detects real defects **74** of the mass production wafer **71**, and determines corrected defect coordinates of the real defects **74**. Concretely, step S**14** in FIG. **2** is executed.

In step S**32**, the processing device **21** of the optical type inspection apparatus **1** determines whether or not the correction period counted by the timer **42** (see FIGS. **1**A to **1**C) has reached a predetermined period. If the correction period has reached the predetermined period (step S**32**, Yes), the process returns to step S**22**, and the correction factors are reset. If the correction period has not reached the predetermined period (step S**32**, No), the process returns to step S**27**, and inspection of the mass production wafer **71** is continued. Thus, as the correction factors can be updated either manually or automatically, even in case that the various errors **58**-**63** change, it is possible to obtain highly accurate corrected defect coordinates by making the coordinate factors follow the change.

DESCRIPTION OF REFERENCE SYMBOLS

1: optical type inspection apparatus (defect inspection device)
11: lighting unit
12: detecting unit
12*a*: photoreceptive unit
12*b*: line sensor (image forming unit)
12*c*: channel
13: stage position detecting unit (Y scale)
14: stage position detecting unit (X scale)
15: lighting device of surface height position detection system
16: detector of surface height position detection system (two detectors for one set: **16***a*, **16***b*)
17: image surface observing unit
18: image processing device
19: stage
19*a*: transporting unit
21: processing device
22: A/D convertor
23: image processing device
24: defect determination device
24*a*: determination circuit
24*b*, **24***c*: factor table
25: stage position detecting unit (coordinate management device)
26: inspection result storage device
27: stage control device
28: image display device
31: coordinate transforming unit
32: difference computing unit
33: characteristic pattern obtaining unit
34: inclination obtaining unit
35: amplitude obtaining unit
36: stage correction factor computing unit
37: channel correction factor computing unit
38: stage correction amount computing unit
39: die correction amount computing unit
40: die coordinate correcting unit
41: storing/transmitting unit
42: timer

51: wafer for coordinates management (wafer)
52: pseudo defect die (chip)
53: die cell
54: pseudo defect
54*a*: formed image of pseudo defect
55: forward scanning
56: reverse scanning
57: shift
58: defect X coordinate error (inclination error)
59: defect Y coordinate error (magnification ratio error)
61: defect X coordinate error (X scale error)
62: defect Y coordinate error (Y scale error)
63: defect X coordinate error (orthogonal degree error)
71: mass production wafer
72: mass production die
73: die cell
74: real defect
80: inspection system
81: process control section
82: review device
83: transportation system
83*a*: stocker
Xs: stage X coordinate (stage coordinate)
Ys: stage Y coordinate (stage coordinate)
Xs**0**: pseudo defect stage X coordinate (pseudo defect stage coordinate)
Ys**0**: pseudo defect stage Y coordinate (pseudo defect stage coordinate)
Xs**1**: real defect stage X coordinate (real defect stage coordinate)
Ys**1**: real defect stage Y coordinate (real defect stage coordinate)
Xd: die X coordinate (die coordinate)
Yd: die Y coordinate (die coordinate)
Xd**0**: pseudo defect die X coordinate (pseudo defect die coordinate)
Yd**0**: pseudo defect die Y coordinate (pseudo defect die coordinate)
Xd**1**: real defect die X coordinate (real defect die coordinate)
Yd**1**: real defect die Y coordinate (real defect die coordinate)
Xd**2**: designed X coordinate (designed coordinate)
Yd**2**: designed Y coordinate (designed coordinate)
ΔX, ΔY: difference
ΔXds, ΔYds: stage correction amount
ΔXdd, ΔYdd: die correction amount
Xdm: corrected real defect die X coordinate (corrected real defect die coordinate)
Ydm: corrected real defect die Y coordinate (corrected real defect die coordinate)
Pd: pitch of pseudo defects
Pds: pitch of formed images of pseudo defects
Pc: pitch of channels
C**1**-C**16**: channel
CP**1**, CP**2**, CP**3**: coordinate error characteristic pattern
A**1**, A**2**, A**3**: amplitude (channel correction factor)
L**1**, L**2**, L**3**: line
AL**1**, AL**2**, AL**3**: inclination of line (stage correction factor)

The invention claimed is:

1. An optical type inspection apparatus including a line sensor with plural channels capable of forming an image of a surface of a wafer, the channels being arrayed with equal intervals along Y axis direction, and a transporting unit that forms an image of an entire surface of the wafer on the channels by loading the wafer on a stage and repeatedly transporting, relatively to the line sensor, the wafer along X axis direction perpendicular to the Y axis direction, wherein the optical type inspection apparatus inspects the surface of the water, the optical type inspection apparatus comprising:

a stage position detecting unit, wherein,

when a wafer for coordinates management has been arranged such that:

a matrix is set on the surface;

one pseudo defect die is formed on each row of the matrix and one pseudo defect die is formed on each column of the matrix; and

plural pseudo defects are formed in the each pseudo defect die in one array along a column direction with equal intervals such that a pitch between formed images, of the pseudo defects, on the channels is the same as a pitch between the channels,

and if the wafer for coordinates management has been inspected as the wafer such that the Y axis direction and the column direction are substantially parallel to each other and an image of one pseudo defect is formed on the each channel, corresponding to the each pseudo defect die,

then the stage position detecting unit detects a position, on the stage, of the each pseudo defect whose image has been formed on the corresponding channel, as a pseudo defect stage coordinate;

a coordinate transforming unit that transforms the each detected pseudo defect stage coordinate into a pseudo defect die coordinate representing a position in the pseudo defect die that includes the pseudo defect;

a difference computing unit that computes difference of the each pseudo defect die coordinate from a designed coordinate based on design, wherein the difference is generated when the pseudo defect is formed in the corresponding defect die; and

a characteristic pattern obtaining unit that obtains at least either one of a coordinate error characteristic pattern in which the difference vibrates with a substantially constant amplitude with respect to the pseudo defect stage coordinate and a coordinate error characteristic pattern in which the difference increases or decreases along a line.

2. The optical type inspection apparatus according to claim **1**, comprising:

an inclination obtaining unit for obtaining inclination of the line; and

a stage correction factor computing unit for computing a stage correction factor that is an error ratio to transportation of the stage, based on the inclination of the line.

3. The optical type inspection apparatus according to claim **2**,

wherein when a mass production wafer provided with mass production dies has been inspected as the wafer:

the stage position detecting unit detects as a real defect stage coordinate a position, on the stage, of a real defect on the mass production wafer, an image of the real defect having been formed on the corresponding channel; and

the coordinate transforming unit transforms the detected real defect stage coordinate into a real defect die coordinate that represents a position in the mass production die that includes the real defect;

and wherein the optical type inspection apparatus comprises:

a stage correction amount computing unit for computing a stage correction amount, based on the detected real defect stage coordinate and the stage correction factor;

a die coordinate correcting unit for correcting the real defect die coordinate, based on the stage correction amount; and

a storing/transmitting unit for storing the corrected real defect die coordinate or transmitting the corrected real defect die coordinate to outside.

4. An inspection system, comprising:

the optical type inspection apparatus according to claim **3**; and

a review device that receives the corrected real defect die coordinate, and displays, with magnification, periphery of the corrected real defect die coordinate in the mass production die corresponding to the corrected real defect die coordinate.

5. The optical type inspection apparatus according to claim **2**, comprising:

an amplitude obtaining unit for obtaining magnitude of the amplitude; and

a channel correction factor computing unit for computing a channel correction factor that is a ratio of error caused by the channels to the pitch between the channels, based on the magnitude of the amplitude.

6. The optical type inspection apparatus according to claim **1**, comprising:

an amplitude obtaining unit for obtaining magnitude of the amplitude; and

a channel correction factor computing unit for computing a channel correction factor that is a ratio of error caused by the channels to the pitch between the channels, based on the magnitude of the amplitude.

7. The optical type inspection apparatus according to claim **6**,

wherein when a mass production wafer provided with mass production dies has been inspected as the wafer:

the stage position detecting unit detects as a real defect stage coordinate a position, on the stage, of a real defect on the mass production wafer, an image of the real defect having been formed on the corresponding channel; and

the coordinate transforming unit transforms the detected real defect stage coordinate into a real defect die coordinate that represents a position in the mass production die that includes the real defect;

and wherein the optical type inspection apparatus comprises:

a die correction amount computing unit for computing a die correction amount, based on the detected real defect die coordinate and the stage correction factor;

a die coordinate correcting unit for correcting the real defect die coordinate, based on the die correction amount; and

a storing/transmitting unit for storing the corrected real defect die coordinate or transmitting the corrected real defect die coordinate to outside.

8. An inspection system, comprising:

the optical type inspection apparatus according to claim **7**; and

a review device that receives the corrected real defect die coordinate, and displays, with magnification, periphery of the corrected real defect die coordinate in the mass production die corresponding to the corrected real defect die coordinate.

9. The optical type inspection apparatus according to claim **1**,

wherein the pseudo defect stage coordinate includes a pseudo defect stage X coordinate based on a coordinate axis that is parallel with the X axis direction,

wherein the pseudo defect die coordinate includes a pseudo detect die X coordinate that is transformed from the pseudo defect stage X coordinate and based on a coordinate axis that is parallel with the X axis direction,

wherein the designed coordinate includes a designed X coordinate based on the coordinate axis that is parallel with the X axis direction,

wherein the difference is generated in a direction parallel with the X axis direction,

and wherein the coordinate error characteristic pattern is at least either one of a coordinate error characteristic pattern in which the difference vibrates along the X axis direction with the amplitude, accompanying an increase in the pseudo defect stage X coordinate, and a coordinate error characteristic pattern in which the difference increases or decreases along the line in the X axis direction, accompanying the increase in the pseudo defect stage X coordinate.

10. The optical type inspection apparatus according to claim **9**,

wherein the pseudo defect stage coordinate includes a pseudo defect stage Y coordinate based on a coordinate axis that is parallel with the Y axis direction,

wherein the pseudo defect die coordinate includes a pseudo detect die Y coordinate that is transformed from the pseudo defect stage Y coordinate and based on a coordinate axis that is parallel with the Y axis direction,

wherein the designed coordinate includes a designed Y coordinate based on the coordinate axis that is parallel with the Y axis direction,

wherein the difference is generated in a direction parallel with the Y axis direction,

and wherein the coordinate error characteristic pattern is at least either one of a coordinate error characteristic pattern in which the difference vibrates along the Y axis direction with the amplitude, accompanying an increase in the pseudo defect stage Y coordinate, and a coordinate error characteristic pattern in which the difference increases or decreases along the line in the Y axis direction, accompanying the increase in the pseudo defect stage Y coordinate.

11. The optical type inspection apparatus according to claim **1**,

wherein the pseudo defect stage coordinate includes a pseudo defect stage Y coordinate based on a coordinate axis that is parallel with the Y axis direction,

wherein the pseudo defect die coordinate includes a pseudo detect die Y coordinate that is transformed from the pseudo defect stage Y coordinate and based on a coordinate axis that is parallel with the Y axis direction,

wherein the designed coordinate includes a designed Y coordinate based on the coordinate axis that is parallel with the Y axis direction,

wherein the difference is generated in a direction parallel with the Y axis direction,

and wherein the coordinate error characteristic pattern is at least either one of a coordinate error characteristic pattern in which the difference vibrates along the Y axis direction with the amplitude, accompanying an increase in the pseudo defect stage Y coordinate, and a coordinate error characteristic pattern in which the difference increases or decreases along the line in the Y axis direction, accompanying the increase in the pseudo defect stage Y coordinate.

12. The optical type inspection apparatus according to claim **1**,

wherein the pseudo defect stage coordinate includes a pseudo defect stage Y coordinate based on a coordinate axis that is parallel with the Y axis direction and a pseudo defect stage X coordinate based on a coordinate axis that is parallel with the X axis direction,

wherein the pseudo defect die coordinate includes a pseudo detect die X coordinate that is transformed from the pseudo defect stage X coordinate and based on a coordinate axis that is parallel with the X axis direction,

wherein the designed coordinate includes a designed X coordinate based on the coordinate axis that is parallel with the X axis direction,

wherein the difference is generated in a direction that is parallel with the X axis direction,

and wherein the coordinate error characteristic pattern is at least either one of a coordinate error characteristic pattern in which the difference vibrates along the X axis direction with the amplitude, accompanying an increase in the pseudo defect stage Y coordinate, and a coordinate error characteristic pattern in which the difference increases or decreases along the line in the X axis direction, accompanying the increase in the pseudo defect stage Y coordinate.

13. A wafer for coordinates management,

wherein a matrix is set on a surface of the wafer for coordinates management,

wherein only one pseudo defect die is formed on each row of the matrix and only one pseudo defect die is formed on each column of the matrix,

and wherein plural pseudo defects are formed on the each pseudo defect die with equal intervals only in one array along column direction of the matrix.

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